DESIGN, CONSTRUCTION, OPERATION OF METAL-WORKING AND ALLIED EQUIPMENT

MACHINERY

DECEMBER, 1942

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Every number of MACHINERY records time-saving methods and equipment developed to speed the production of the vital weapons of warfare, as well as a variety of other material of interest to the designer and production executive. Among the articles scheduled for the January number of MACHINERY are: "Manufacturing Boosters for High-Explosive Shells," and "Unusual Grinding Operations on War Work."

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MACHINERY

Volume 49 NEW YORK, DECEMBER, 1942 Number 4

Making a World-Famous Automatic Pistol

By E. P. HERRICK, Production Engineer
Colt's Patent Fire Arms Mfg. Co., Hartford, Conn.

Approved for Publication by the War Department

Tried and Tested in the First World War, the Colt 0.45 Automatic Pistol is Now Being Manufactured in Larger Quantities than Ever Before. The Reputation of This Famous Firearm has been Established by the Care and Precision of Its Manufacture

THE first successful American automatic pistol was developed and introduced by the Colt's Patent Fire Arms Mfg. Co. in 1900. It was of 0.38 caliber, and its construction was based on Browning's patent, which featured a magazine feed, recoil ejection of the empty cartridge cases, and automatic cocking of the hammer after each shot was fired. It was in many ways a marked improvement over the re-

volver with bulky cylinder and hammer that had to be manually cocked before each shot.

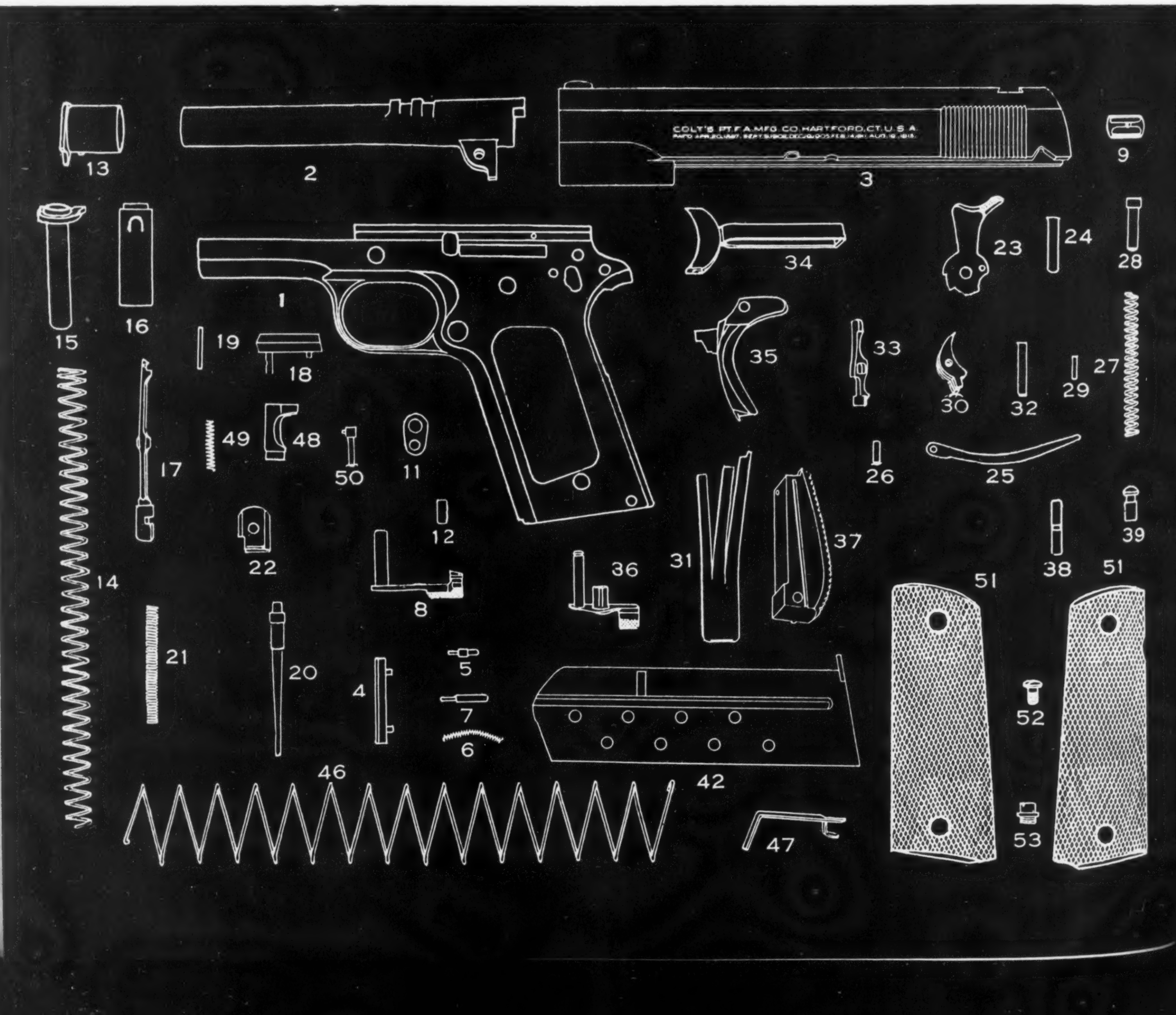
In 1905, the first Colt Military Model 0.45 caliber automatic was introduced. After extensive and rigorous tests by the United States Government, it was adopted with slight modifications as the standard hand gun for the Army, Navy, and Marine Corps in 1911. Since that time, with the addition of one or two refinements in construction, it has continued to be unsurpassed as an automatic side arm for accuracy and reliability of operation.

During the first World War the Colt Government Model was used extensively by our Expeditionary Forces, and to supply the quantities needed, two firms were authorized to manufacture it, besides the Colt's Patent Fire Arms Mfg. Co. Today it is recognized that the automatic pistol still fills a unique and important place in the armory of modern warfare. It is being manufactured in greater quantities than ever before, and three companies, in addition to the Colt's organization, have been authorized to engage in its production.

The present Government Model 0.45 Colt automatic is a compact, well balanced pistol weighing 39 ounces. It is about 8 1/2 inches long and has a magazine capacity of seven shots. The action of the pistol is automatic, except that the trigger must be pulled to fire each shot. It can be discharged at the rate of five shots per second, the cartridges being automatically supplied from a detachable magazine inserted in the handle of the pistol.

The fifty - three parts of which the pistol is composed are shown in Fig. 1, and most of them are also shown in the assembly drawing, Fig. 2. The materials of which the various parts are

Fig. 1. Fifty-three Different Parts Make up the Colt Automatic Pistol. All except the Plastic Stocks are Made of Steel. The Names of the Parts are Listed in the Table on the Opposite Page



★ WAR PRODUCTION

Fig. 2. Cut-away Side View of Assembled Pistol, Showing Receiver, Slide, Barrel, Recoil Spring, Firing Pin, Trigger, Hammer, and Firing Mechanism. Some Parts are Not Visible in This View. Loaded Magazine is Shown at Left

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Material Specifications for Colt Government Model 0.45 Automatic

Part No.	Name	Size and Grade of Steel
1	Receiver	2 1/4" by 1", S A E 1035
2	Barrel	Special Shape, S A E 4150
3	Slide	1 1/8" sq., Special Grade, H.R., S A E 1050 Unannealed
3½	Recoil Plate	0.290" diam. Dukane Drill Rod, Carbon Tool, S A E 1095
4	Plunger Tube	5/16" by 3/16", S A E 1025
5	Slide-Stop Plunger	0.106" diam., S A E 1115
6	Plunger Spring	0.018" diam. Music Wire AA
7	Safety-Lock Plunger	0.106" diam., S A E 1115
8	Slide Stop	7/16" sq., S A E 1075
9	Rear Sight	Special Shape, S A E 1020 C.D.
10	Front Sight	1" by 0.057", S A E 1020 C.R.
11	Barrel Link	7/8" by 0.135", S A E 1095
12	Barrel-Link Pin	0.155" diam. Dukane Drill Rod, Carbon Tool, S A E 1075
13	Barrel Bushing	1 1/4" diam., S A E 1075
14	Recoil Spring	0.043" Music Wire AA
15	Recoil-Spring Guide	13/16" diam., S A E 1045, H.R., Annealed
16	Recoil-Spring Plug	17/32", S A E 1025
17	Extractor	9/32" diam., S A E 1075
18	Ejector	5/8" by 7/32", S A E 1075
19	Ejector Pin	0.063" diam. Dukane Drill Rod, S A E 1095
20	Firing Pin	1/4" diam. Dukane Drill Rod, S A E 1095
21	Firing-Pin Spring	0.026" Music Wire AA
22	Firing-Pin Stop	3/4" by 5/32" plus or minus 0.002", S A E 1075
23D	Hammer	13/16" by 3/8", S A E 1075
24	Hammer Pin	0.180" diam. Dukane Drill Rod, S A E 1095
25	Hammer Strut	2 3/8" by 0.105", S A E 1095
26	Hammer-Strut Pin	0.095" Dukane Drill Rod, Carbon Tool, S A E 1095
27	Mainspring	0.045" Music Wire AA

Part No.	Name	Size and Grade of Steel
28	Mainspring Cap	0.278" diam., S A E 1120 C.D.
29	Mainspring-Cap Pin	0.109" diam., S A E 1120 C.D.
30	Sear	3/8" sq., S A E 1075
31	Sear Spring	19/32" by 0.030", S A E 1095
32	Sear Pin	0.134" Dukane Drill Rod, Carbon Tool, S A E 1095
33	Disconnector	5/16" sq., S A E 1075
34	Trigger	3/4" by 3/8", S A E 1020
35	Grip Safety	3/4" diam., S A E 1020
36	Safety Lock	3/4" by 5/8", S A E 1075
37	Mainspring Housing	13/16" by 21/32", S A E 1020
38	Mainspring-Housing Pin	0.155" diam. Dukane Drill Rod, Carbon Tool, S A E 1095
39	Mainspring-Housing Pin Retainer	0.275" diam., S A E 1120 C.D.
40	Lanyard Loop	0.106" diam., S A E 1120 C.D.
41	Lanyard-Loop Pin	0.092" diam. Dukane Drill Rod, Carbon Tool, S A E 1095
42	Magazine Tube	Special Shape, S A E 1050
43	Magazine Base	Special Shape, S A E 1020
44, 45	Magazine-Base Pin	0.0625", S A E 1120 and S A E 1115 C.D.
46	Magazine Spring	0.047" Music Wire Regular
47	Magazine Follower	17/32" by 0.042", S A E 1020, C.R., Soft Annealed
48	Magazine Catch	17/32" diam., S A E 1020
49	Magazine-Catch Spring	0.023" Music Wire AA
50	Magazine-Catch Lock	0.281" diam., S A E 1120 C.D.
51R	Stock, R.H.	Colt Rock Plastic
51L	Stock, L.H.	Colt Rock Plastic
53	Stock Screw Bushing	S A E 1120

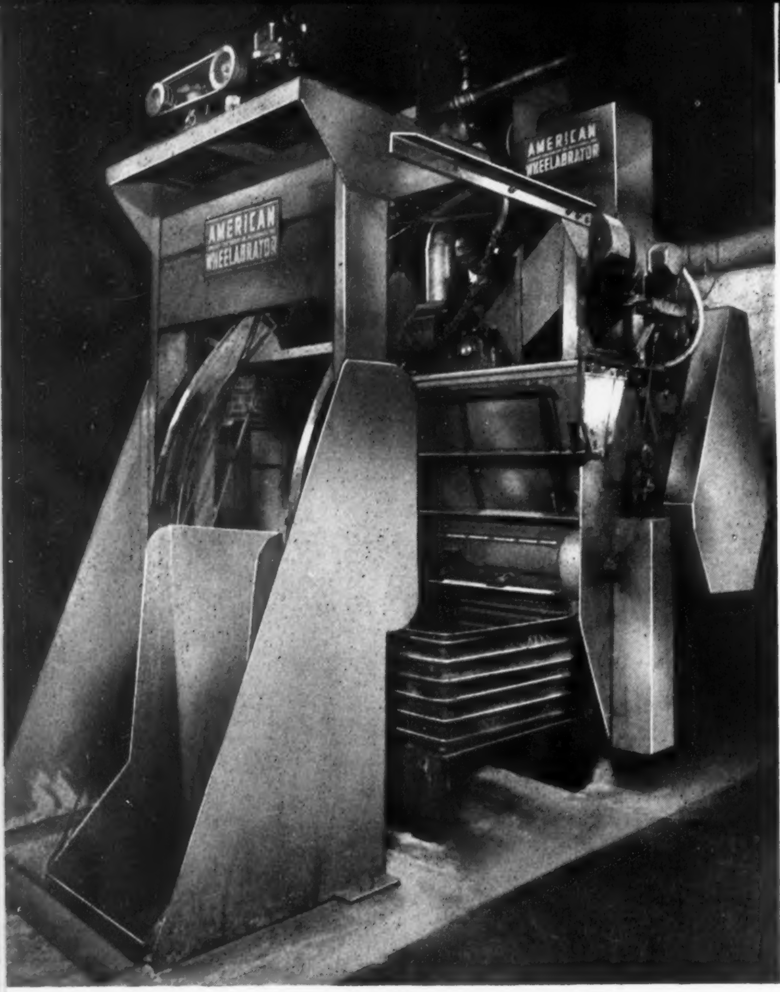

Fig. 3. Forgings are Tumbled in This Machine, and are also Cleaned by Sand, which is Whirled against Them by a Rapidly Rotating Wheel. Four Tumbling Machines were Replaced by This One Machine

made are listed in the accompanying table. This article will deal chiefly with the machining operations on the three main parts—the receiver, the slide, and the barrel.

Machining Operations on the Receiver

The receiver is the main body of the pistol into or on which are fitted most of the other fifty-two parts. One hundred and sixteen operations are required in its fabrication. The raw stock from which the receiver is made is 2 1/4- by 1-inch S A E 1035 steel. This is cut into 7 1/8-inch lengths, which are hot-forged into rough shape. The rough forging is than finish-forged, trimmed, and subjected to a grain refinement. A second trimming operation is followed by the punching out of the guard for the trigger.

The forgings are then taken to a Wheelabrator Tumblast (made by the American Foundry Equipment Co.), which is shown in Fig. 3. Here they are charged into a drum in which they are tumbled about by rotating action, and are also subjected to the continuous impact of very fine shot. This shot is not propelled by compressed air, but is discharged from above on a rapidly rotating wheel from which it is thrown with considerable centrifugal force against the forgings. The combined action of tumbling and shot impact rapidly removes all rust and scale.

Only eight to ten minutes is needed to accomplish in this one machine what formerly required three-quarters of an hour to an hour in four tumbling machines. After cleaning, those forgings that require a slight straightening are given a cold strike, and then are ready for the first machining operation.

Five receiver blanks, mounted together, have their top outlines milled on a heavy-duty Pratt & Whitney horizontal milling machine, as shown

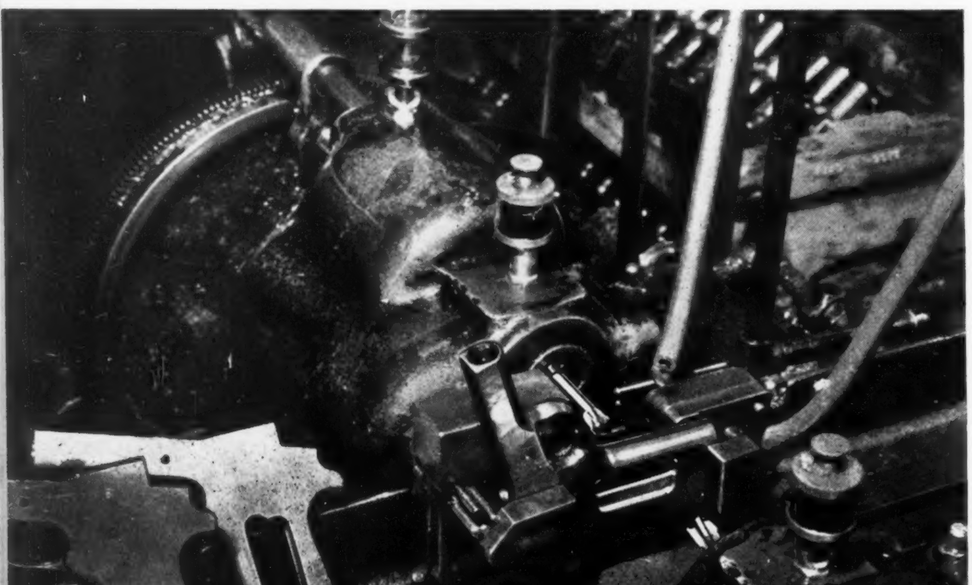

Fig. 4. To Lighten the Receiver, a Rectangular Opening is Cut through the Handle. Two Slots are Spline-milled to Form the Rough Opening. The Two Small Holes in the Blank have been Previously Drilled for Locating the Piece in Subsequent Operations

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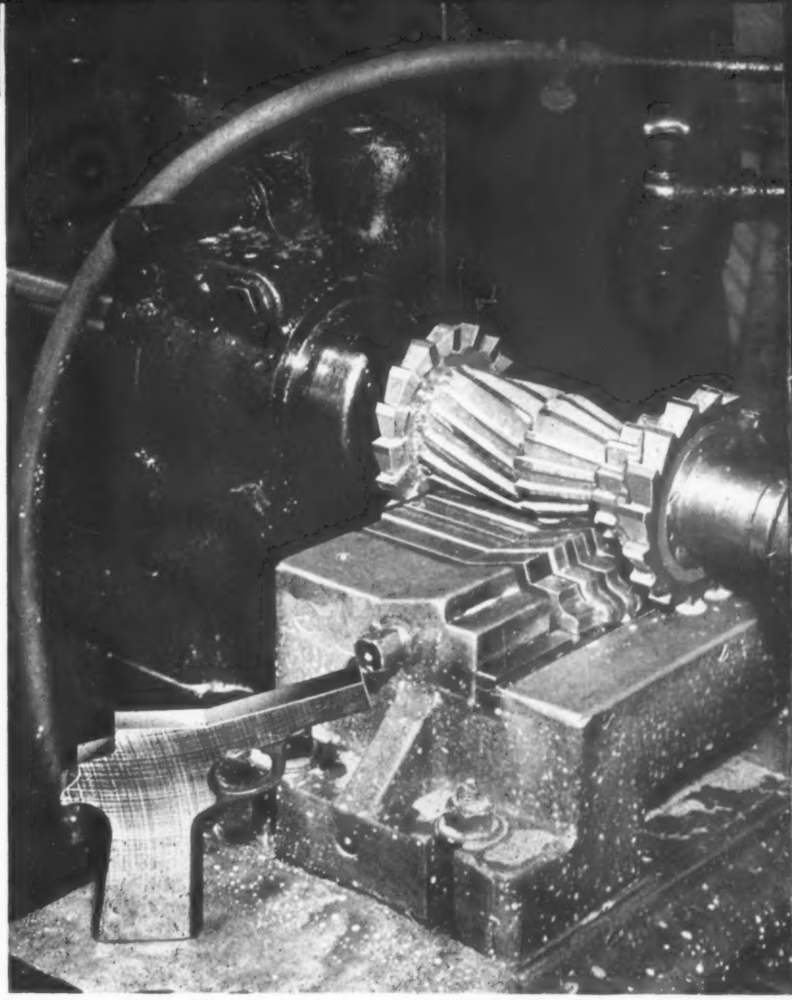

Fig. 5. First Milling Operation on Receiver is Profiling of Top Outline. Here Seven Distinct Surfaces are being Milled on Five Blanks in One Operation. Blank with Finished Profile Seen at Left

in Fig. 5. Seven distinct edges or surfaces are milled on each receiver in this operation with one pass of the interlocking cutters. (The blank with finished profile, shown at the front of the machine, has also had several subsequent operations performed on it.) The next operation is to drill and ream two holes which serve as position locators for subsequent machining operations. This is followed by profile milling of the front of the grip or handle, the bottom and front of the trigger guard, and the bottom of the forward part of the receiver up to the muzzle end.

The first operation in forming the magazine cavity is the cutting of a hole through the end of the handle with a deep-hole drill. This is followed by the drilling of a large hole in the barrel end of the receiver, which will eventually form part of the recoil-spring housing. A rectangular-shaped opening is cut through the handle on the side to lighten the weight of the receiver. This opening is formed by two spline milling operations. Fig. 4 shows the second operation.

In this operation, a milling cutter is fed into each side of the handle, and both cutters are then traversed to form a slot type of opening. After cutting to full depth, one cutter is retracted slightly, so that the other may be plunged deeper to cut away the metal separating the two cavities, thus forming an opening through the handle. Each cut is about 2 3/16 inches long and 0.770 inch deep. A similar operation on another machine forms a slot into which this slot opens, completing the rough shape of the opening as shown in the finished blank in Fig. 4. Also shown in both finished and unfinished blanks are two small holes previously drilled, which serve as position locators for subsequent operations.

The top and bottom of the magazine hole through the end of the handle are next spline-milled to enlarge the cavity, after which each

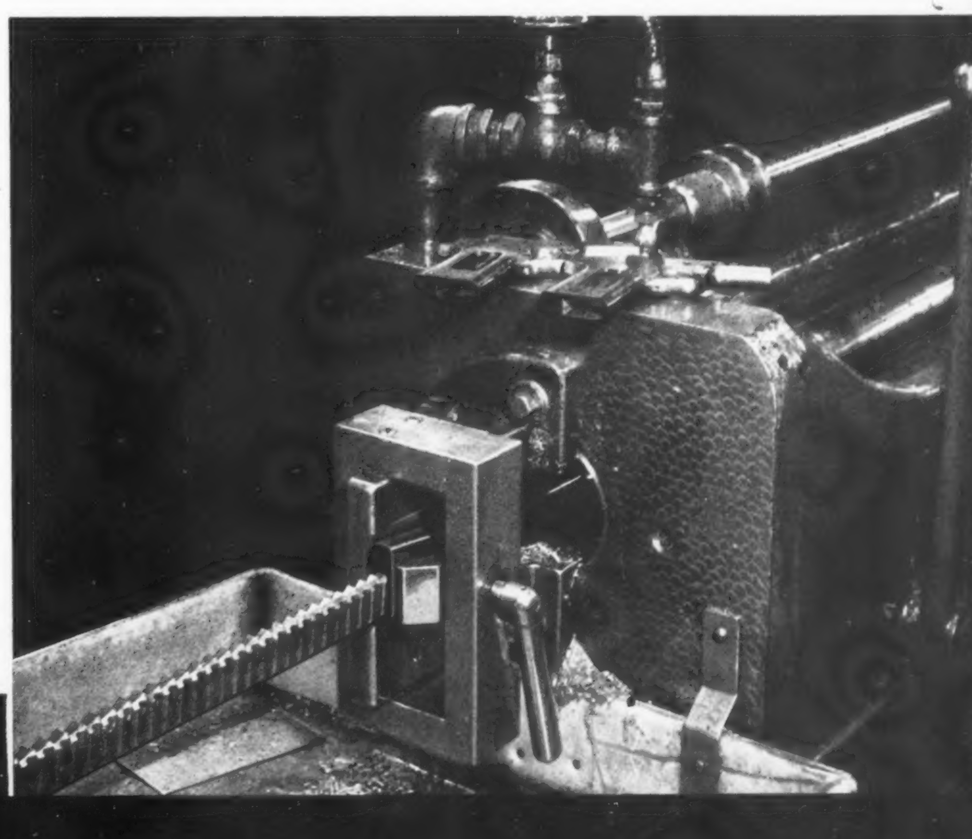

Fig. 6. The Curved Back Surface of the Rough Magazine Cavity in the Receiver Handle is Broached to a Flat Surface. Two Receiver Blanks Showing the Cavity Outline before and after the Broaching Operation are Directly above the Work-holding Fixture

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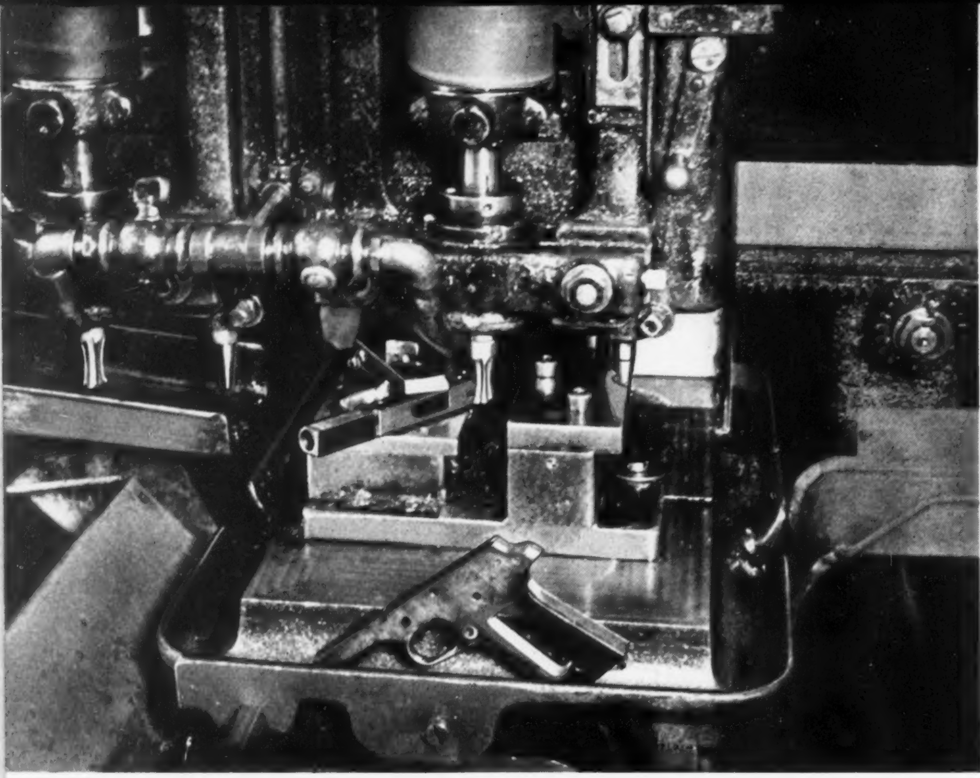

Fig. 7. Profile Milling the Contour around the Hammer Guard of the Receiver. A Receiver with Finished Hammer-guard Profile is Shown at the Front of the Machine

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piece is gaged. The inside of the opening through the side of the handle is then rough-profiled. In the finished gun, this opening is covered by a plastic stock on each side. The rough-profiling is followed by a low-temperature anneal to break down the glaze formed by milling.

The rounded back of the magazine cavity is broached to form a square, flat surface in a Lapointe broaching machine, as shown in Fig. 6. The work is located in the machine by two studs bearing on the top of the receiver, which is held tightly against a pad at the left side. A 28-inch broach is used, and the cut taken is 5 inches long and 1 3/8 inches wide.

The inside of the opening through the side of the handle is now finish-profiled and both sides of the receiver are disk-ground. Following the rough and finish cam-milling of the inside of the trigger guard, a profiling cut is taken on the right and left sides of the guard, and the outside of the trigger guard is also rough-profiled.

The succeeding machining operations on the receiver include rough-milling a slot at the rear of the handle to form a recess for the mainspring housing; milling a slot in the hammer guard, finish-milling the top and bottom of the receiver; finish-milling the slot for the mainspring housing; drilling, reaming, and countersinking several small holes on both sides; and disk-grinding both sides of the receiver.

Next, another profiling cut is taken around the hammer support to form a profile that will blend with the outline of the rear of the slide when it is in place. This operation, which is performed on a Pratt & Whitney two-spindle vertical milling machine, is shown in Fig. 7. A

Fig. 8. Shaving a Slot in Top of the Receiver to Form a Square End for Barrel Stop. Of the Two Receivers Seen at the Front, the One with the Finished Cut is on Top

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small curvature is then rough- and finish-milled on the rear of the grip.

Following this, the slide ribs or ways are milled on the right- and left-hand sides just below the top edge of the receiver, and the rear profile of the trigger guard is cut. The upper wall of the recoil-spring hole is removed by cutting in from the left side on a hand milling machine and then breaking off the thin top piece, leaving an open channel. The sides of this open channel, which forms a seat for the rear portion of the recoil spring, are then milled to flat surfaces. The next operation is the milling of the hammer slot.

As may be seen by referring to the assembly drawing, Fig. 2, the rear loop of the trigger extends back to the firing mechanism. The groove in which this trigger loop slides is milled in the next operation. Following this, two profiling cuts are taken to provide a seat for the grip safety, which is at the rear of the handle just below the trigger guard. The second of these two cuts is shown being performed in Fig. 9.

Next the barrel seat is milled and the disconnector hole counterbored. Various other holes are drilled and reamed, and then begins a series of shaving operations, one of which is shown in Fig. 8. In this operation, the top hollowed portion of the receiver just back of the recoil-spring

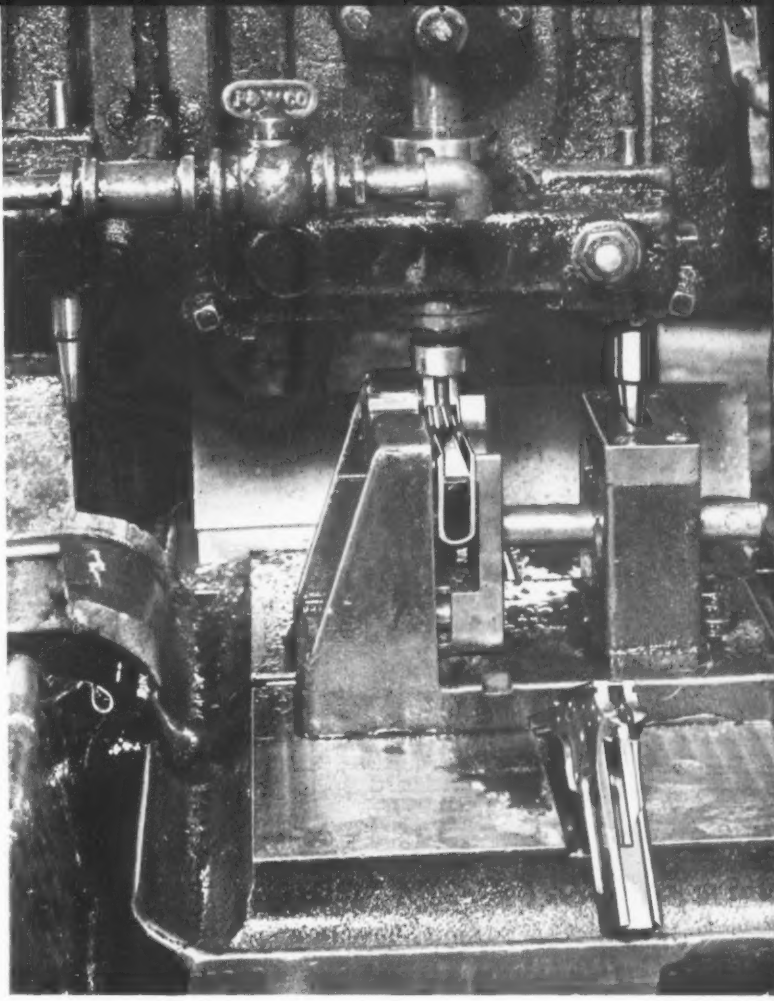
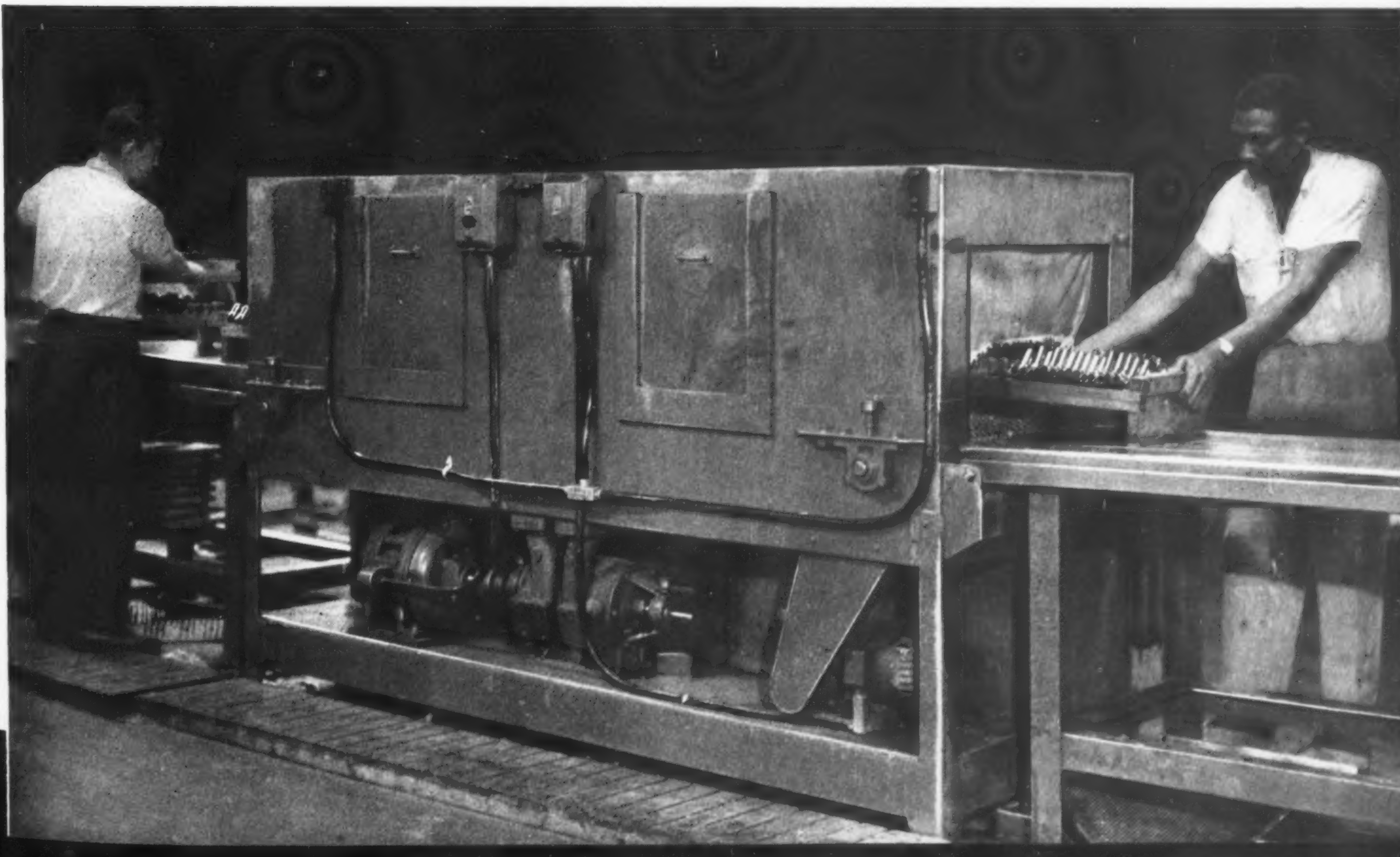


Fig. 9. Milling out a Recess in the Rear of the Receiver for the Grip Safety. This Cut is Taken well up Inside the Hammer Guard. A Receiver with Finished Recess is Shown at the Front of the Machine

Fig. 10. To Facilitate Machining, Each Trayful of Parts is Cleaned after Every Operation in an Automatic Washing Machine. Here a Tray of Receivers is Seen being Removed from the Spray Chamber of the Washing Machine



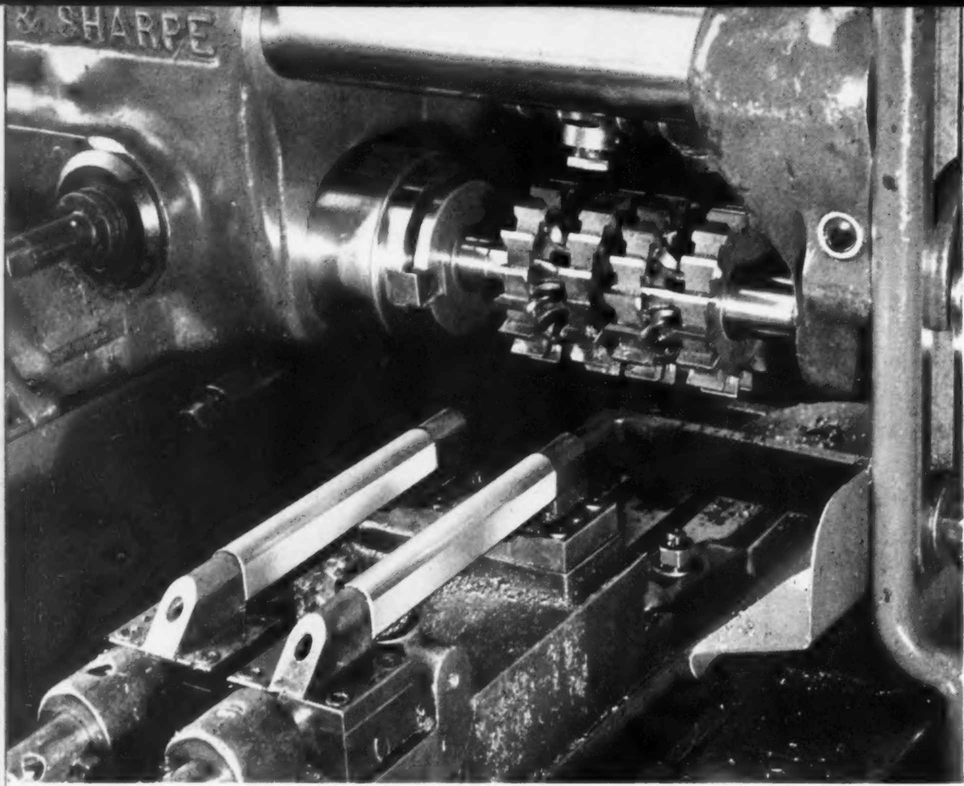


Fig. 11. Two Slides being Straddle-milled to Form a Curved Top Surface and Straight Sides. Each Slide is Held by Pins which Fit into the Barrel-bushing Hole, the Recoil-spring Hole, and the Centered Hole at the Rear End

★

channel is cut further back to form a square end for the barrel stop. This operation is accomplished on a shaving machine with automatic feed, which was built by the Taylor & Fenn Co. to Colt's own design.

Because there is a slight hollow in the top of this middle section, the depth of the cut is not uniform, and ranges from about 1/4 inch at ach edge to about 1/16 inch in the center. The feed is about 1/64 inch. The receiver is located in the machine by a block bearing against the top and by two pins which fit into two locating holes previously drilled in the receiver blank.

The remaining machining operations on the receiver consist in providing slots, holes, or recesses for the parts that fit into the receiver.

One of the practices followed at the Colt plant to make certain that all parts will be in suitable condition for machining is to clean them after every operation in a Colt automatic washing machine. Fig. 10 shows one of these machines with a tray of receivers just emerging from the washing chamber, where they have been sprayed with a hot soda solution. This particular model machine has a washing chamber 8 feet long, through which a loaded tray will pass in about fifty seconds. The machine is operated continuously for approximately twenty-three hours, and then is shut down for an hour to permit the removal of accumulated waste and chips. When a tray of parts has passed through this washing chamber, the parts are thoroughly cleaned and ready for the next machining operation.

Wooden trays similar to those shown in Fig. 10 hold about thirty parts. From the time the tray is loaded with blanks for the first machining op-

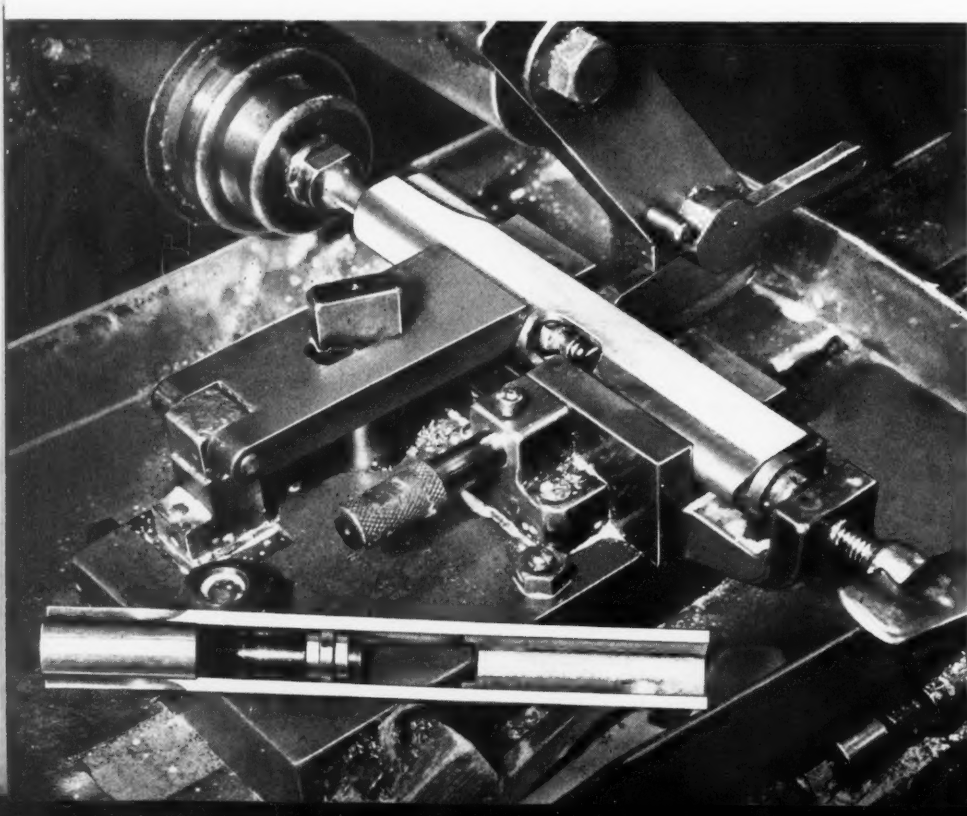


Fig. 12. Two Locking Grooves are being Milled at the Top of the Inside of the Slide just in Front of the Carriage Outlet. A Small Cutter is Used at the End of a Long Spindle Supported by an Arm

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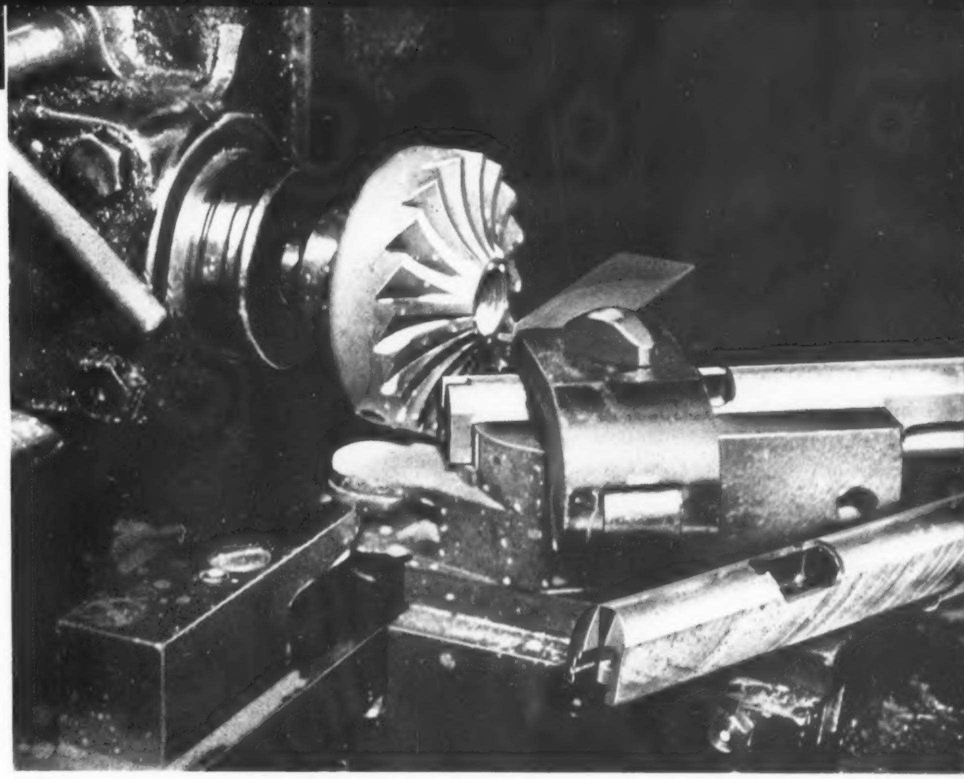

Fig. 13. A Double Curvature is Milled on the End of the Slide by Using a Concave Cutter to Form the Vertical Curvature and a Rotating Action of the Work-holding Fixture to Generate the Horizontal Curvature

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eration up to the point where each receiver is assembled with a slide, the pieces in each tray travel from one machining operation to another together. A serial number is assigned to every tray and a record is kept of the machinist who performs the operations on each part.

During the various operations on the parts, most of the gaging is done only by the operators themselves. Each operation is checked, however, about once an hour by floor inspectors, and the piece last finished at the time of the inspection is gaged to make sure that the operation is being conducted correctly.

To prevent later difficulties in assembly, each part is carefully checked for "skipped operations" before leaving the machine shop. Parts that have been rejected because some dimension falls outside of the established limits are also inspected and sorted into scrap and salvage. The latter go to a special group of workmen who reclaim such parts by skillful hand work, thereby saving valuable machining time and material.

The most thorough gaging and operational inspection of each part is made as it proceeds through final filing and finishing operations. In addition to company inspection, the finished parts are, of course, subjected to a complete and thorough gaging and visual examination by U. S. Army inspectors.

Function of the Slide

The slide is that part of the automatic pistol which rides on top of the receiver, enclosing the barrel and the firing pin. When the pistol is fired, the pressure of the powder gases drives

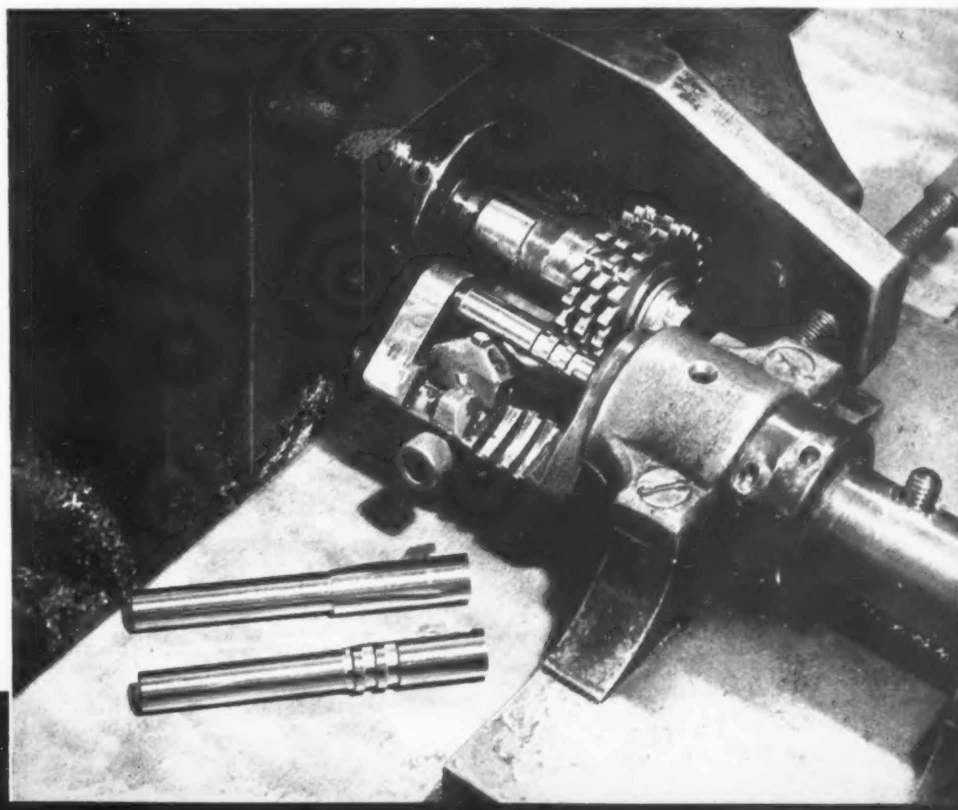

Fig. 14. Locking Slots are Milled on the Top of the Breech Section of the Barrel by the Use of a Rotating Work-fixture. The Front Slot is Cut Shallow to Allow for Blending with the Barrel Section Contour

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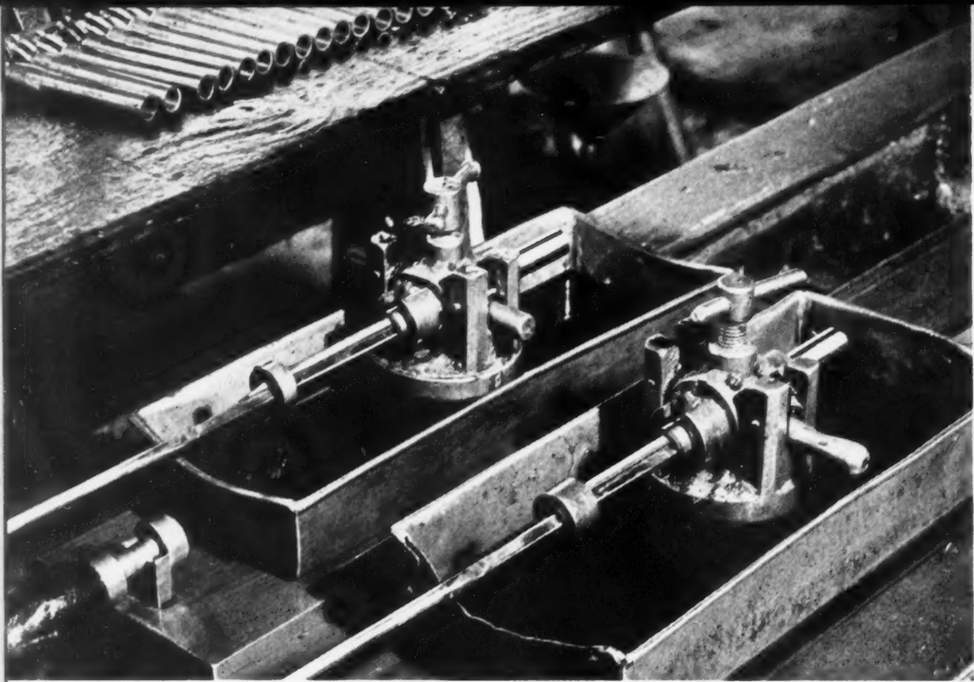
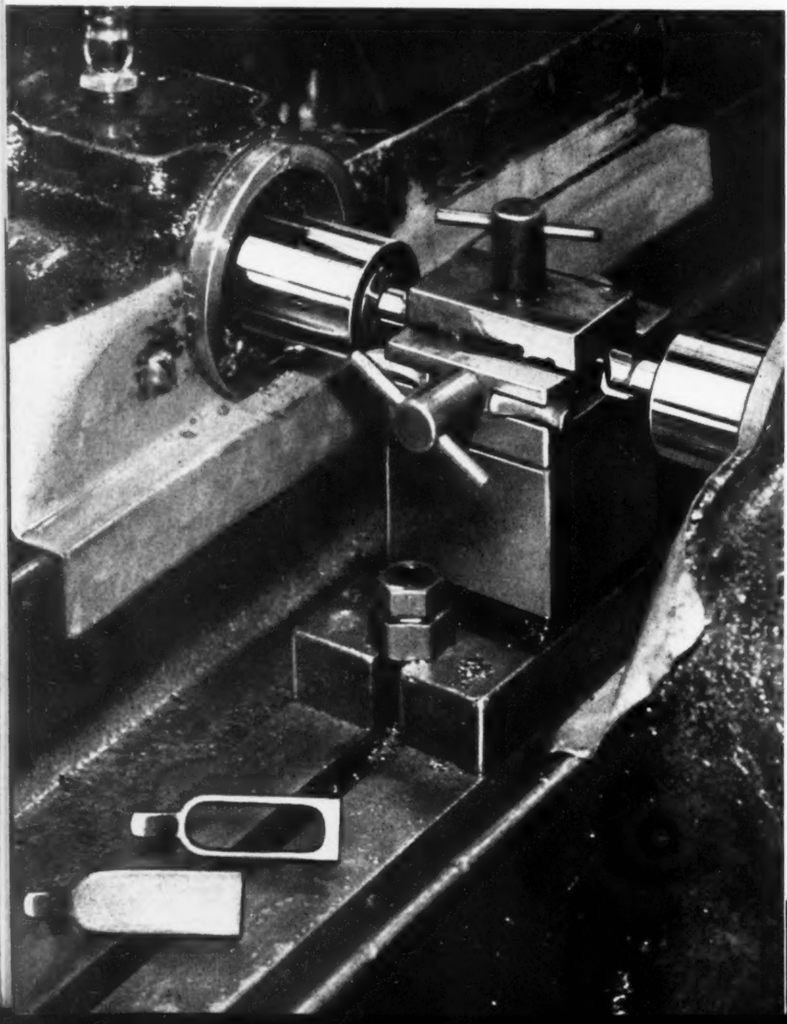


Fig. 15. Final Finishing of the Bore before Rifling is Accomplished with a Square Reamer. A Wooden Guide is Placed against One Side of the Reamer to Hold the Cutting Edge Steadily and Firmly against the Work

★

the bullet forward, and at the same time, forces the slide and barrel together toward the rear. After a short distance of travel, the barrel, which swings on a link pivoted on the receiver, moves downward and disengages the slide, so that the latter is free to continue its rearward movement. In so doing, the slide cocks the hammer, extracts and ejects the empty shell, and compresses the recoil spring. After completing its rearward movement, it is driven forward again by the compressed recoil spring, and in its forward movement, carries the barrel back to the firing position and also forces a fresh cartridge from the magazine into the chamber.



The initial operations on the slide are similar to those performed on the receiver. They consist of hot forging, annealing, shot-blasting, trimming, and "cold striking" where straightening is needed. The first machining operation is to straddle-mill the bottom and the ends of the slide. This is followed by the drilling of the hole for the barrel with a deep-hole drill and disk-grinding of one end.

A heat-treating operation is employed to remove the hard glazed surface formed by the previous operation. At this point the slide is subjected to a preliminary gaging before subsequent machining.

Following this, the rear end is center-drilled and reamed, and a hole is drilled and reamed in the lower abutment at the front of the slide to receive the recoil-spring plug.

Milling the Contour of the Slide

In Fig. 11, the sides and top of two slides have just been cut to the proper size and contour in a straddle-milling operation. Each piece is located by pins which fit into the barrel-bushing hole, the recoil-spring hole, and the centered hole at the rear end. The operation gives the slide a rounded top and straight sides.

Then follows the rough-milling of a slot along the bottom of the slide, which extends down into the barrel hole and lengthwise to the rear of the slide. This provides a recess in which ribs will

Fig. 16. To Form the Opening in the Trigger Slide through which the Magazine Passes, a Spline-milling Operation is Used. The Finished and Unfinished Pieces are Shown in the Left Foreground

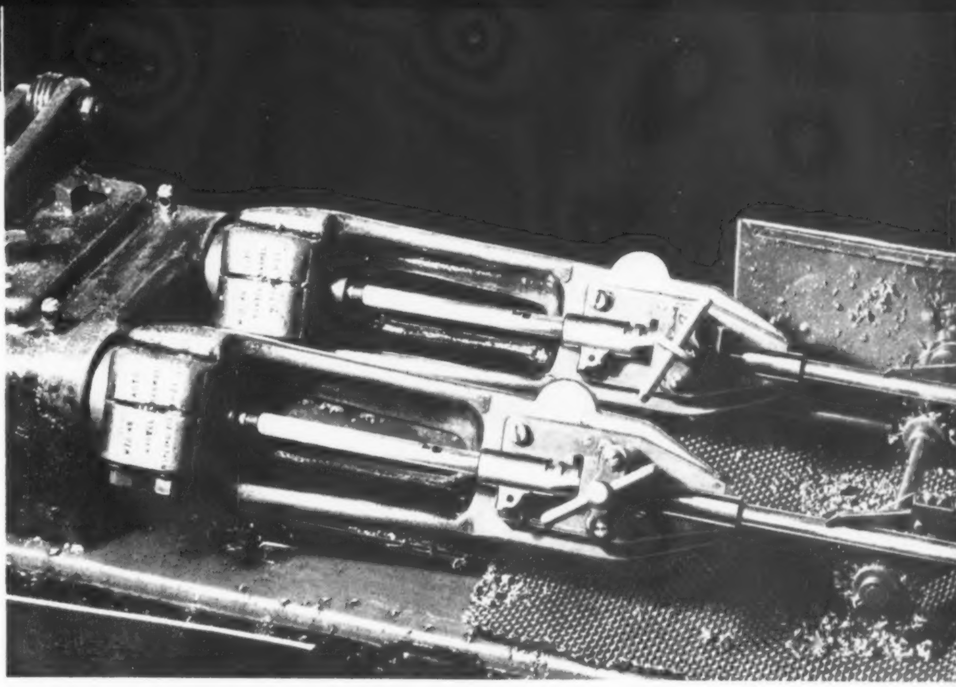


Fig. 17. Rifling Two Colt 0.45 Automatic Barrels. The Cutters are Shown Retracted below the Surface of the Rifling Head, Ready for Return to Starting Position. At Each Forward Stroke 0.0001 Inch of Stock is Removed

be later cut to match similar ribs along the top of the receiver. The abutment underneath the front end of the slide is next milled along both sides of the bottom, and ornamental cuts are milled on each side to form a pleasing contour where the top of the abutment joins that part of the slide surrounding the barrel. Another slot is milled on the bottom for the receiver and the ejector, and a clearance is milled on the bottom to allow room for the top of the magazine.

Ribs are now cut inside the slot previously formed to accommodate the top of the receiver; these ribs provide ways which fit into grooves along the outside edge of the receiver, permitting the slide to move easily backward and forward.

A recess is drilled for the extractor with a deep-hole drill, the recoil hole is countersunk, and the first cut is taken on a spline milling machine to form the cartridge outlet opening. Clearance for the linking arrangement which connects the barrel with the receiver is provided by a shaving operation. A seat for the cartridge head is also produced by a shaving cut, and a second cut is taken on a hand milling machine to enlarge and shape the cartridge-outlet opening, through which the empty shells are ejected.

Milling Locking Grooves Inside the Slide

Rather a difficult operation is that of milling the transverse locking grooves into which fit matching ribs on the barrel. This is accomplished on a hand milling machine. Since these grooves must be cut well up inside the slide, a small milling cutter mounted on a long spindle is used, which can be inserted through the barrel hole, as shown in Fig. 12. The outer end of the cutter-spindle is supported by an arm, as shown. In this operation, the slide is located from the front of the cartridge-outlet opening, which is held firmly in contact with a locking pin by pressure exerted through a thumb-screw at one end of the holding fixture.

This operation is followed by the milling of the cartridge-head seat and the barrel clearance, and chamfering of the cartridge outlet. A seat

Fig. 18. Automatic Screw Machines are Used in Making Some of the Smaller Parts. Here a Recoil-spring Guide is Turned, Drilled, Formed, and Cut off. The Rough Stock and Finished Piece are Shown in the Foreground

is reamed and counterbored for the extractor, the function of which is to remove the empty shell from the barrel before it is ejected through the slide opening, and the breech block and the slot extending the length of the slide along the bottom are finish-milled. The hammer slot is milled in the rear of the slide and the firing-pin hole drilled with a deep-hole drill.

In Fig. 13 is shown the milling of the double curvature on the rear end of the slide. A concave milling cutter forms the vertical curvature, while the horizontal curvature is generated by the action of the cutter as the work - holding fixture rotates the end of the slide across it. A roller attached to the front of the work-holding fixture is shown in contact with the front push member, which is mounted on a reciprocating cross-slide. This front member rotates the work for the cut, while a similar member at the rear end of the slide moves the work-holding fixture back into position for reloading after the cut has been completed.

Following this, profiling cuts are taken for the firing-pin stop, safety-lock and slide stop, and the angle on the rear of the slide-stop notch is formed by shaving. The front end is then faced and milled to receive the barrel-bushing locking nut.

Various filing, reaming, and burring operations are followed by a preliminary inspection. Both sides of the slide are then ground, and the vertical serrations that provide a grip to pull the slide backward in the initial loading operation are milled. The top curvature of the slide is ground, and the front end is finish-milled.

Succeeding operations provide for the location of the recoil plate, sights, and disconnector, and the rolling of the name and model designation on the side. The slide is then hardened for a length of 2 inches from the bore end, and after this, it is tempered at 850 to 900 degrees F. Before it is "butted up" with the receiver in a test assembly, it is thoroughly cleaned electrolytically. This process consists of a three- to four-minute dip in a hot soda solution through which an electric current is passed, a three-minute dip in a dilute muriatic acid solution, a cold water rinse, another three-minute dip in the electrolytic soda solution, followed by a hot water rinse and drying under air blowers. After cleaning, the barrel receptacle and spring holes are given a final reaming.

The slide is then fitted to a receiver in the "green state." A working barrel and recoil spring are used. After filing to the desired fit, the slide is tried or "butted up" with thirty different receivers in succession to test its interchangeability.

Following a rigid inspection of all critical dimensions of the slide, it is polished, stamped as having passed inspection, and the front sight is mounted at the muzzle end.

Although all of the parts of this automatic pistol were at one time finished by bluing, most of them are now Parkerized. In this finishing operation, the slide is first cleaned in an alkali bath, then sand-blasted with flour grade sand, rinsed in warm water, and placed in the Parkerizing solution for about fifteen minutes. The bluing operation took five hours. After Parkerizing, the slide is rinsed in hot water, dried, and a coating of oil applied to prevent rust.

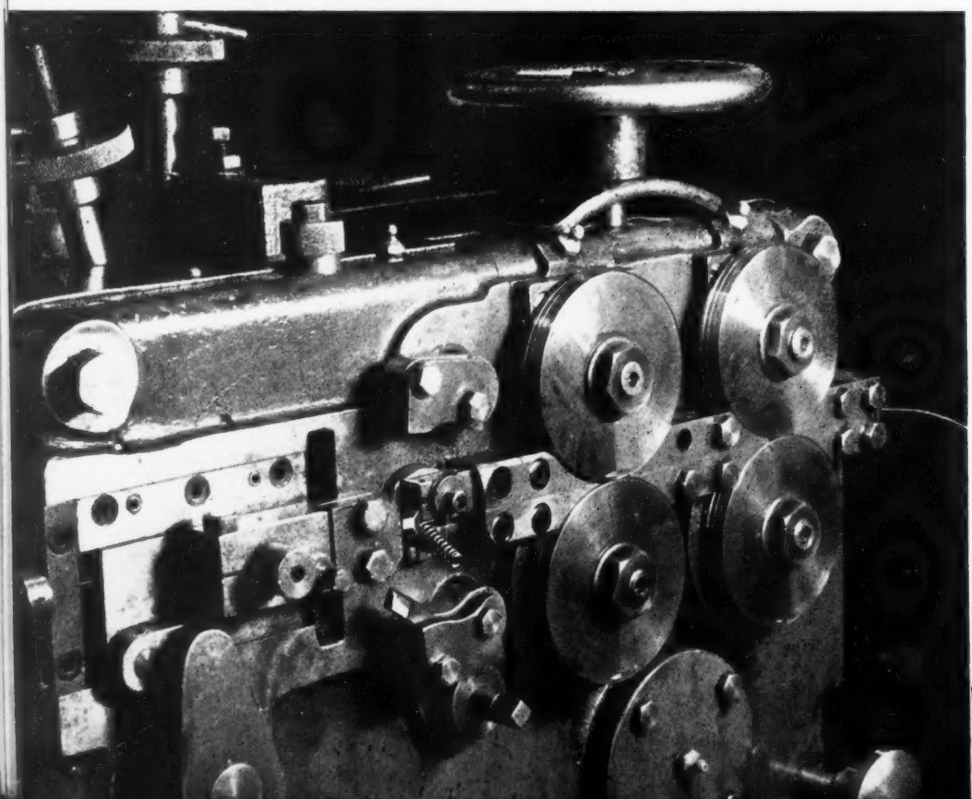


Fig. 19. The Mainspring, which Actuates the Hammer when Trigger is Pulled, is Produced on the Automatic Spring-making Machine Illustrated. The Finished Spring Must be Held within Close Limits for Weight, Length, Diameter, and Deflection for Given Load

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Forty-Two Operations Required on the Barrel

The making of the barrel for the Colt 0.45 automatic requires forty-two operations. A modified S A E 1350 steel in the form of a special shape is used, and this is cut to length, normalized, hardened and drawn, and then pickled to remove scale.

The first machining operation is the straddle-milling of the ends and bottom of the barrel, as well as the front and back of the barrel-link lug. The butt end is turned down for chucking, and the bore is drilled with a deep-hole drill to a diameter of 0.430 inch, after which it is reamed to a diameter of 0.439 inch.

The breech and muzzle sections are turned to different diameters, and then the muzzle section is ground to 0.580 inch diameter, and the breech section to 0.696 inch diameter. The working slot in the link lug is next milled, and this is followed by the straddle-milling of the sides and top of the link lug. The curved surface of the barrel that lies directly adjacent to the link lug is then rough-finished in a rotary milling operation. In the finish-grinding operations, an eccentric arrangement on the rotating head oscillates the work-piece. The rear end of the link lug is milled and faced, as well as the breech end of the barrel itself.

The transverse ribs which interlock with the grooves on the interior of the slide are next milled around the top of the breech section, as shown in Fig. 14. Three slots are milled with a tolerance of 0.002 inch on the width and depth of each cut. The front slot, which is to be blended with the contour of the muzzle section, is made 0.004 inch shallow for finishing. The fixture shown holding the barrel in the illustration is rotated as the cutters are engaging the work, thus generating the grooves. The milling machine on which this operation is performed is one of Colt's own design.

The hole in the lug which holds the link pin is next drilled, reamed, and burred. After two further operations on the link slot, the barrel bore is given a first and second finish-reaming. The first finish-reaming brings the diameter up to 0.4420 inch plus or minus 0.00025 inch. The second finishing operation, performed by a square reamer, takes off about 0.0015 inch of stock and increases the diameter to within 0.4435 to 0.4440 inch. For the Government Model the diameter should preferably be within 0.4435 to 0.44375 inch. Approximately 0.0005 to 0.00075 inch of taper from the breech end to the muzzle end is allowed.

As can be seen in Fig. 15, the square reamer is backed up on one side with a wooden guide, which holds the reamer's single cutting edge firmly against the surface of the bore, and at the same time, prevents two of the other edges of the reamer from rubbing against the bore wall. The reamer consists of a 0.220-inch square head about 8 inches long, welded to a 0.250-inch shank about 20 inches long, with a chucking arrangement at the end.

Rifling the Barrel

Following inspection of the bore for diameter and surface condition, the barrel is subjected to a lead polishing operation, and then goes to a Pratt & Whitney small arms rifling machine. This machine has two rifling heads, as shown in Fig. 17. Each is 0.4415 inch in diameter, and has a hooked cutter about 0.158 inch wide, which is pushed up through a small opening in the head into cutting position on the forward movement, and drops back below the surface of the head on the retracting movement.

As the cutter moves forward, the barrel is rotated, so that a helical groove is produced. About 0.0001 inch of stock is removed at each cut, and thirty-five cuts are taken on each groove, bringing the bore diameter from bottom of groove to bottom of groove up to 0.450 to 0.451 inch at the muzzle end and 0.451 to 0.452 inch at the breech end, with a 0.001-inch taper from breech to muzzle end. Six grooves are cut, the barrel being indexed after each pass of the cutter.

The next operation is chambering. The rear end of the barrel is countersunk, and about 0.02 inch of stock removed by rough-reaming. A second reaming operation removes 0.003 to 0.004 inch of stock. Following this a burnishing reamer removes up to 0.001 inch, and finally a ball-seat reamer forms a small curved seat at the junction of the bore and the chamber in which the lead bullet is seated. The machine on which these operations are conducted is a Pratt & Whitney chambering machine, made to a special Colt's design.

Returning to the outside of the barrel, the breech section is milled, and this is followed by a straddle-milling operation which blends the contour of the remainder of the barrel with the breech end. Following this, the rear bottom edge of the chamber is chamfered to facilitate introduction of the cartridge from the magazine. The

muzzle end is form-milled to a rounded contour and polished, and the breech end is filed to a square shoulder. The bore is reamed to remove any burrs formed by the rifling cut, and the barrel is inspected, washed, and swabbed with oil.

The barrel is then "proof shot" with a cartridge developing 25 per cent greater breech pressure than an ordinary cartridge. Thus, while the ordinary cartridge develops a breech pressure of from 12,000 to 16,000 pounds, the "proof cartridge" tests the barrel at a pressure of about 20,000 pounds.

After "proof shooting," the barrel is again cleaned and oiled, the cartridge entrance is polished, and a final cleaning and polishing brings the barrel to the point where it can be assembled with the link and pin which will connect it with the receiver. The cartridge incline cut is now chamfered and polished, and the barrel is ready for final finishing.

The barrel cannot be Parkerized, as are most of the other parts, since the action of the solution used would impair the accuracy of the highly finished bore. Instead, a bluing process is used, which produces a smooth, rust-resistant finish without resorting to preparatory sand-blasting. The final operation on the barrel is to roll the designation Colt 0.45 Auto on the side.

Operation on the Trigger Blank

As shown in Fig. 2, the finger grip of the trigger is part of an oblong slide which extends back to the firing mechanism. When inserted in the handle, the magazine extends through the trigger slide. To provide for this, a large opening is milled out of the trigger blank, forming a loop with relatively thin connecting sides which fit into and slide along the trigger grooves in the receiver. The cutting of this opening is accomplished by a spline-milling operation, as shown in Fig. 16. The cut is 0.230 inch deep and a little over 1 1/2 inches long. By utilizing a spline-milling machine, two triggers are cut at one time, as shown.

Several of the small parts which enter into the pistol mechanism are turned out on automatic screw machines. One of these—the recoil-spring guide — is almost completely machined on a Greenlee multi-spindle automatic screw machine, as shown in Fig. 18. Five stations are utilized to turn, drill, form, and cut off the finished piece. The rough stock is in the form of 144-inch lengths of 13/16-inch diameter S A E hot-rolled and annealed steel rod, which is turned down on one end for chucking.

At the first station, the small diameter of the piece is rough-turned. At the second station, the

Fig. 20. Final Assembly of the Colt 0.45 Automatic Pistol Requires Much Careful Bench Work to Insure Accurate and Reliable Operation. More of These Pistols are Now being Produced than ever before in the Company's History

large diameter, forming the disk, is turned and the front end of the piece spot-faced. At the third station, the piece is drilled to a 17/64-inch diameter for a depth of about 3/8 inch and a 45-degree chamfer is cut on the disk end. At the fourth station, the depth of the hole is extended to 3/4 inch and the rear side of the disk is faced. At the fifth station, the drilling is completed through the piece and it is cut off. The finished piece is 1.760 inch long, within plus 0.000, minus 0.020 inch, and has an outside diameter of 0.336 inch, plus 0.000, minus 0.003 inch, and an inside diameter of 0.265 inch, plus 0.006, minus 0.000.

Springs play an important part in the operation of this automatic pistol. They vary in size from the slide-stop plunger spring, which is about 3/32 inch outside diameter and 9/16 inch long when fully extended, to the magazine spring, which is 1 1/4 inches outside diameter and 7 1/2 inches long when fully extended. In each case, diameter, length, weight, and deflection for a given load must be held within close limits. All of the springs in this pistol are made by Colt's.

In Fig. 19 is shown a mainspring, which actuates the hammer when the trigger is pulled, being produced on a Torrington spring-making machine. This spring has 21 1/2 coils of 0.045-inch diameter AA music wire. It must have an external diameter of 0.273 inch, within plus 0.000, minus 0.006 inch. Assembled in the gun, it will have a load of 18.05 pounds placed upon it when the hammer is not cocked. A load of 26.02 pounds would be required to compress it to a solid position.

The last operations on the pistol, which cover preliminary and final assembly, require a good deal of careful bench work and exhaustive gaging and testing. All parts must work together smoothly and exactly. The test of this is the "proof shooting" given every assembled pistol. One final inspection follows, and the automatic then receives its "V.P.," or verified proof of its accuracy and reliability.

★ ★ ★

Assembling Studs in Stud-link Anchor Chain for the U. S. Naval and Merchant Fleets at the S. G. Taylor Chain Co.'s Plant. The Press Exerts Sufficient Force to Decrease the Width of the Links and thus Lock the Studs in Place

BRAIN POWER MOBILIZATION

★ We hear a great deal today about man power mobilization; little about the mobilization of brain power. Yet the two must march along together. In the War Production job, the pace depends on engineering brains.

★ The striking power of the United Nations is geared directly to the speed with which our factories can equip the men at the front. Every idea, therefore, that speeds up War Production means more power to the fighting forces—on land, on sea, and in the air.

★ A step-up in War Production speed, quality, and quantity may eventually add up to the difference between victory and defeat. Our score on these essentials will reflect the extent to which the engineering brains of the country have been put to work.

★ With invigorating boldness, the Ordnance Department has conceived a Brain Power Mobilization plan that is already producing important results. Ideas and practical suggestions that may lead to improved practices are invited. A staff of outstanding engineers receives, analyzes, and sorts out these ideas that come in from the four corners of industrial America, passing along to the war industry plants the ones that can be put effectively to work.

★ Already this service has resulted in important economies in the use of critical materials, improved quality, and increased speed and volume of production, not to mention the man power economy effected at the same time.

★ The Ordnance Department brochure, "Metalurgency," reproduced in the following pages, gives an excellent example of the work being done. In addition to applauding the idea as a most constructive step, MACHINERY welcomes the opportunity to bring this plan to the attention of its readers and joins General Campbell in urging that it be given the widest possible publicity.

★ The appeal of the Ordnance Department is a challenge to mechanical America. Is there less ingenuity, resourcefulness, and inventive ability among our engineers today than when American brains originated interchangeable manufacture and made mass production possible or when the submarine, machine gun, airplane, and caterpillar tractor were produced? The evidence points to the contrary. We believe that mechanical America has what the country needs, but all of the brain power has not been mobilized. Have you a practical idea that will help Uncle Sam?

Publisher

FOREWORD

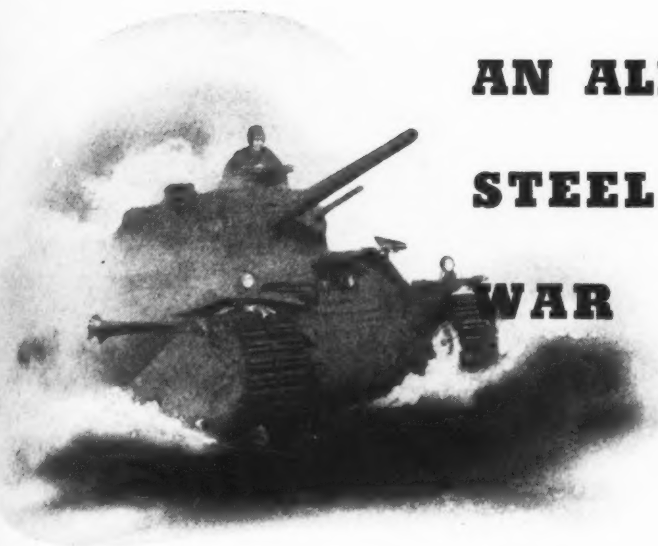
The booklet "Tremendous Trifles," distributed August 15, 1942, was produced to crystallize the redesign and conversion program of Army Ordnance, and bring the facts of it to the attention of the largest possible group in Industry. While the response was immediate and is encouraging, we want to take this opportunity to remind everyone that the job is far from done and requires even more intensive activity.

A major phase of this is the emergency that exists in the high alloy steel supply. As a part of the program to relieve this situation we present this explanatory booklet "Metalurgency".

Because there is so much to be done, and so many people are involved, we request that recipients of this booklet give it as wide circulation as possible. Reprinting, quoting or reproduction of the whole or any part is encouraged. Publicity in consumer, trade papers and employee publications is requested for the benefit of our War effort.

L. H. Campbell, Jr.

L. H. CAMPBELL, JR.
MAJOR GENERAL, CHIEF OF ORDNANCE



AN ALLOY STEEL WAR

● World War II has been called a Production War and a Mechanized War, but basically it is an Alloy Steel War.

A Mechanized or Production War would not be possible were it not for alloy steels. Steel itself is a generic term and there are almost as many kinds of steels as there are machines. Every steel we have is a combination of iron and one or more other elements, each combination having specific qualities, such as hardness, toughness, elasticity, tensile strength, stretchability and machinability. For instance, armor plate must be hard enough to stop projectiles. Projectiles must be harder to pierce armor plate. Shell cases must be elastic to be easy to withdraw from the gun after firing and gun barrels must have the tensile strength to withstand the firing pressure. The pins that hold a tank track together must have high wearing qualities, but the steel used in our truck cabs and fenders must be soft enough to be formed between dies.

Metallurgists have given us steels with these characteristics and hundreds of others, by combining various ferro alloys and other elements with iron and by devising ways and means of treating or working them. The most common of these added elements, aside from the ever-present carbon, are nickel, chromium, vanadium, molybdenum, manganese, and silicon. And, there's the rub!

Metalurgency Cause

In peacetime, steels, using these metals, amounted to only about seven (7) per cent of our total steel requirements. In war, the percentage is climbing to twenty (20) per cent of the total. This, plus the fact that with the exception of molybdenum, of which this country has practically all of the world's ore deposits, we are dependent on imports for an appreciable percentage of our supply. Therefore, the metallurgists, who make it possible for us to create our modern war machines, see us faced with a

"Metalurgency" that must be met if we are to reach our War Production goals. We simply could not build our war machine out of the same steels that we used two years ago, because there isn't enough Nickel, Chromium, nor Molybdenum, etc., to put into them.

Nor are we building our war machine out of the same steels we used two years ago. If we were, we would have already hit a production ceiling. Ordnance metallurgists and engineers, industry metallurgists and engineers, both tackled this problem long months ago, and only a specialist would recognize hundreds of today's specifications as akin to those two years old.

Conservation Progress

Army Ordnance is the largest user of our steels, absorbing in its production about sixty-five (65) per cent of the war tonnage. On part of 1942 production and 1943 projections, our armed forces have devised ways and means of saving 72,103,055 pounds of Nickel; 18,313,452 pounds of Chromium; 1,647,870 pounds of Vanadium, with only a 1,131,216 pounds increase in the use of Molybdenum. Army Ordnance has saved 80% of the Nickel, 70% of the Chromium, 75% of the Vanadium, and has used up 88% of the extra Molybdenum. This added war time demand has put a strain on Molybdenum mining and smelting facilities that they were not geared up to handle. Typical of this program to meet the Metalurgency is the accomplishment of the Tank Section. The Chart on page 11 shows saving progress in the specifications of a medium tank. Similar charts could be drawn for other tanks and for hundreds of items in Small Arms, Ammunition, and Artillery.

The Metalurgency has been faced, is still being faced, and must be faced more realistically as the weeks pass. The Alloy Steel War is yet to be won, but the tide is turning.

Fluctuating Supply and Demand

There is no formula for meeting the Metalurgency except the generality, "Reduce the amount of Alloy Steels required for our War Production and do it fast!" The availability of scarce metals is not static. Our supplies are not always certain. The sinking of a ship, or the development of some new machine of war to meet or defeat the enemy, may put an unforeseen demand on our resources. For instance, Industry's and Ordnance's first efforts to save Nickel and Chrome was to step up the use of Molybdenum steel. The table of savings shows the result. Now the problem of Molybdenum is in the forefront. Therefore, Ordnance and Industry have to so surround the multitude of problems that when the necessity arises, a shift can be made.

Safety Requirements Intensified

But, changing the specifications on a gun or a tank, or even on a projectile is a far more serious matter than changing them on civilian devices. Ordnance Material must protect the lives of our soldiers while being effective against the enemy. A gun barrel must be so built that a premature explosion will not shatter it and kill our own gun crew. A new steel for a helmet might even be stronger, but if it is magnetic it will deflect instruments and upset calculations. So it should be appreciated, when you judge the progress made and the serious Metalurgency that exists, that all of these savings must be accomplished without lowering the safety and performance requirements.

Special steels present a difficult problem. While no stone can be left unturned in experimenting with new and special steels, they cannot usually be considered unless production facilities exist in a number of different mills.

This means that every theory, every idea and every design must undergo tests, and in many cases problems have to be solved by the trial and error method. All this has to be done in absolute secrecy from the enemy.

The Integration Problem

This gigantic business of making war is far more complex than any single peacetime industry. In fact, it is obvious that all-out war has brought a great majority of our industries together on the single job. The primary task therefore has been to integrate all industries, just as many individual industries have been integrated for the mutual benefit of the individual companies.

The Automotive and other industries have patent pools, whereby after a period of time all manufacturers have the advantage of developments that will enable them to produce a better product at a lower cost. In effect, Army Ordnance has set up a patent and idea pool.

Today it is easier than ever before for one section of Ordnance to take advantage of the mechanical, electrical and metallurgical developments of the other. It is also easier for a manufacturer or engineer to make a contribution to many sections instead of just one.

It is this type of coordination that is meeting the Metalurgency and winning the Alloy Steel War.

How Conservation is Effected

We have said that there is no formula for cracking the Metalurgency, except to think, try, test, think and try again. It would require a full library on Engineering, Chemistry and Metallurgy to cover the wide ramifications of the subject. It is further unwise to divulge outside of Army and Navy circles, all of the intimate facts in connection with the developments taking place, and that must take place.

In the face of these facts, however, Army Ordnance recognizes that all-out war requires all of the brains, ingenuity and energy of this country. Therefore, this booklet will illustrate a variety of general procedures that have resulted in conservation of scarce materials, with the hope that they will serve to open up lines of thought and experimentation to many readers with resultant multiplication of the accomplishments already recorded.

NATIONAL EMERGENCY STEELS

● With a full knowledge of what was ahead, early in the conflict, a program to develop National Emergency Steels was inaugurated

The American Iron & Steel Institute, The Society of Automotive Engineers, the War Production Board, Army Ordnance, and other branches of the service cooperated in incorporating, testing and cataloging series of steels including smaller quantities of the scarce ferro-alloys.

Some of these steels have been and still are in use. Others were the result of laboratory efforts. Still others became usable to replace high alloy steels because of new or improved production, treating or working processes.

One fairly common characteristic of National Emergency Steels, however, is that the ferro-alloys in them are largely provided by the alloy scrap that goes into the heat and therefore less virgin alloy metals are required. This reduces the strain on ore deposits, mining, smelting and transportation.

Army Ordnance has adopted and used these lower alloy steels in hundreds of applications. They have been incorporated into Army specifications and together with several other carbon and alloy steels are known as W. D. (War Department) Steels.

This W. D. Classification has been established and is incorporated on all of the million-odd Ordnance drawings to give Army Ordnance the necessary control over specifications, particularly the multitude of changes that occur as alloy supplies and redesigns require them.

This system simplifies the training and work of Ordnance Inspectors by giving them standardized acceptable and non-acceptable limits.

Examples of this substitution and accompanying saving are illustrated on next page.

90 MM. Anti-Aircraft Gun

A prime example of ferro-alloy conservation is the 90 mm. Anti-Aircraft Gun. Several parts were changed to low alloy N. E. type Steels and others even to plain Carbon Steel. These changes will make an accumulative saving in 1943 of 300,000 pounds of Nickel.

Operating Rod Handle M-1 Rifle

In this part, W. D. 8750 (N. E. 8749) Steel was substituted for W. D. 6150 Chrome Vanadium Steel with a saving which in 1943 will amount to well over 12,000 pounds of Chromium and more than 4,000 pounds of Vanadium.

Trigger Guard and Follower Rod Body M-1 U. S. Rifle .30 Cal.

These two parts were formerly made from 6150 Chrome Vanadium Steel. Now that it has been changed to W. D. 4050 Carbon Molybdenum Steel, approximately 40,000 pounds of Chromium and over 3,000 pounds of Vanadium will be saved in 1943.

Browning Machine Gun

A change in the type of steel in many parts of the Calibre .30 M1919A4 Browning Machine Gun is now in effect and in 1943 will save 460,000 lbs. of Nickel.

Tank Track Pin

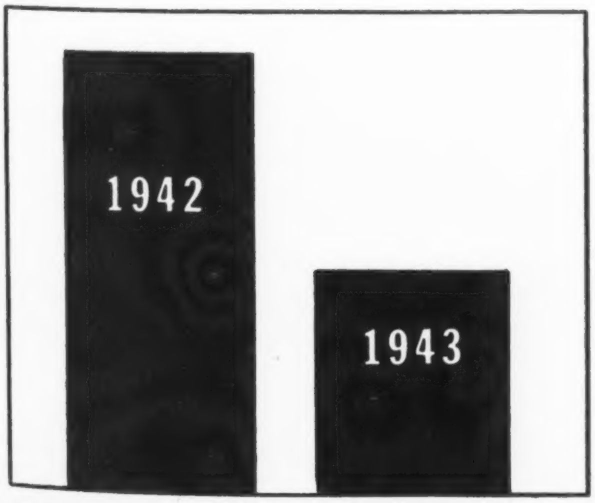
These pins have to take the wear and strain of linking Tank Track Shoes together. W. D. 8750 Steel (N. E. 8749) is now doing the job in place of W. D. 3250 Nickel Chrome Steel and quenching difficulties have been eliminated in addition to the Nickel and Chromium saved.

Cast Breech Ring

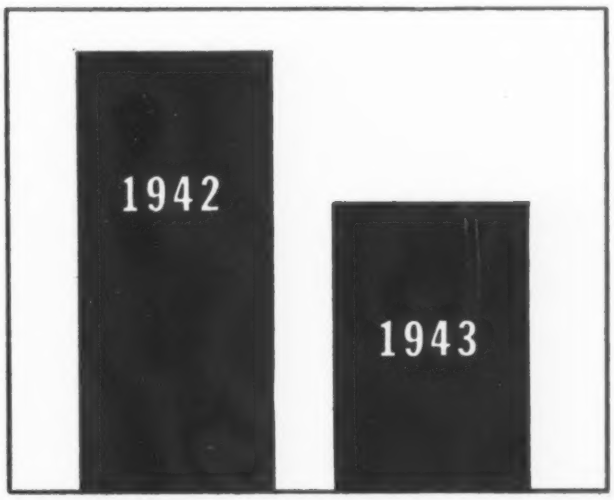
Here is an example of how a simple change to a steel casting from a forging, before machining, resulted in a tremendous saving. By using a sand core to obtain certain contours, the weight before machining was reduced, machining time was saved, cost of the rough part was cut to one-fourth, and every month we are saving 30 Tons of Nickel and 20 Ton of Chromium.

Welding Rod

Our stepped-up tank building program and the increased use of welding has boosted the tonnage of welding rods required. However, here again the adoption of another type of steel will save 4 million pounds of Nickel and 2 million pounds of Chromium in 1943.



FERRO ALLOYS REQUIRED FOR 90 mm. AA GUN



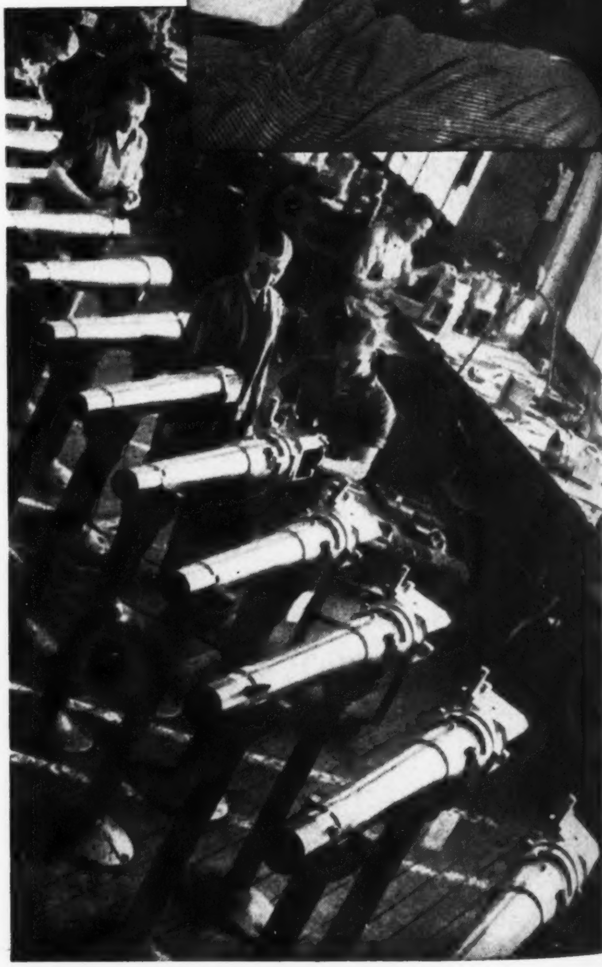
FERRO ALLOYS REQUIRED FOR M-1 RIFLE

NEW

MANUFACTURING

METHODS

●Here are two new ways of making gun or cannon barrels that are helping to meet the Metalurgency. They are the Method "X" which cannot be revealed and the Centrifugal Casting method as contrasted with the method whereby a solid forging is machined inside and out.



Method "X"

Only about ⅓ of the ingot weight is required by Method "X". The amount of machining and scrap is also reduced materially.

While these two facts show an obvious saving in Chromium, Vanadium, and Nickel required for ingots, there is a further saving made possible by this process. Because of the hardening effect of hot working on thinner sections, a lower alloy steel may be used. Further reductions by the use of a low alloy N. E. Steel are being tested.

A saving of 360 tons of Nickel and 6 tons of Vanadium per month is now in effect, because the nature of the process, plus cold working, provides the strength formerly given by the greater quantities of ferro-alloys.

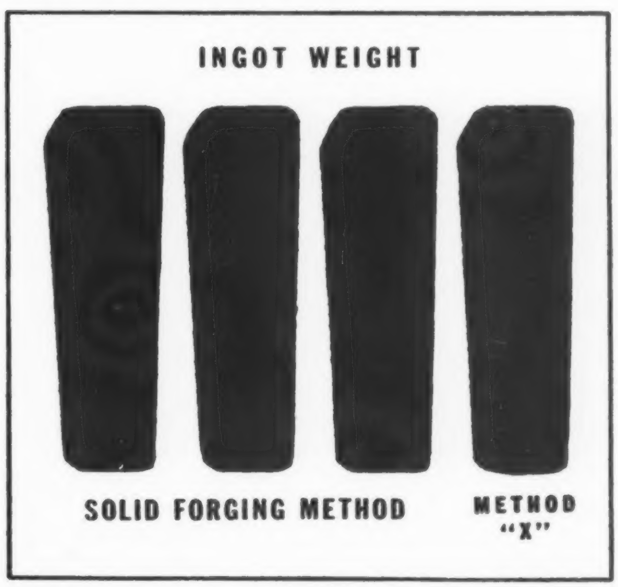
Other Centrifugal Castings

This same centrifugal casting method of forming the rough shape is used to save scarce ferro-alloys in many other war parts. For instance, there are the sprockets used in the Tank driving mechanism. Since centrifugal casting produces a better structure for this purpose and places the hardest metal near the circumference where the wear is greatest, a lower alloy steel is used.

Centrifugal Casting Method

Again rough metal weight and consequent alloy weight is saved by the Centrifugal Casting Method because the casting is hollow and nearer to final shape.

ALLOY STEEL SAVINGS — GUN BARREL MANUFACTURE



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HEAT TREATING

The art of developing desired physical characteristics in metals by heat treating has become highly developed, and in Army Ordnance it is probably responsible for more conservation of scarce ferro-alloys than any one other thing.

Heat treating has been touched on under other headings, but the field is so broad that it deserves a chapter all of its own.

To illustrate the possibilities, here is a "touch and go" pair of illustrations—armor plate and armor piercing projectiles.

Armor Plate

Armor plate must stand up under the pounding that enemy armor piercing shells will subject it to. It must be hard and tough. For these reasons it has been one of the heavy consumers of hardening and toughening alloys. But engineers and metallurgists have so refined heat treating processes that without any reduction in ballistic

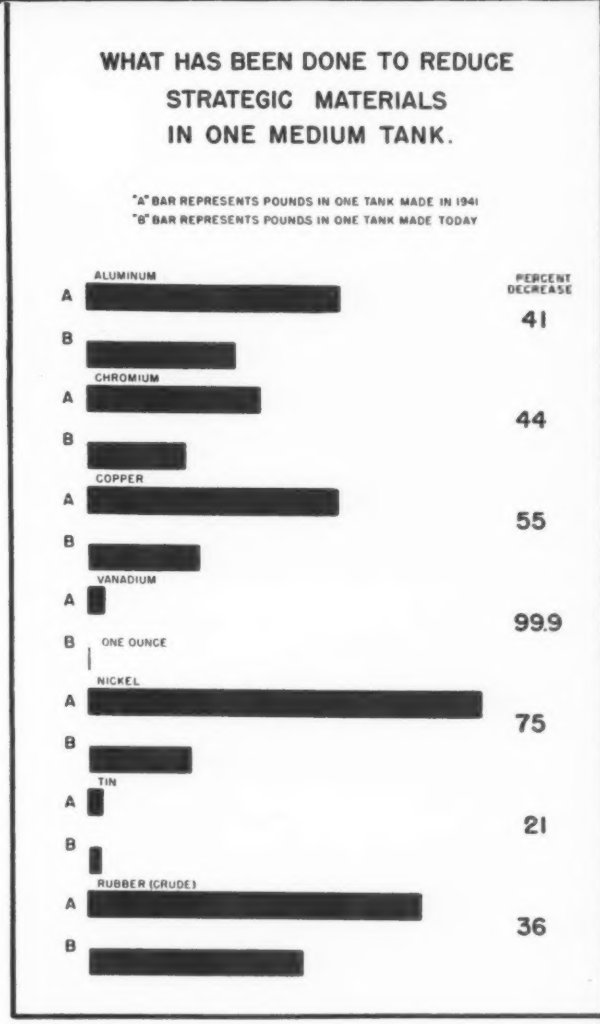
requirements, on current production every month, Army Ordnance is saving 520 Tons of Nickel, 100 Tons of Chromium and 16 Tons of Vanadium.

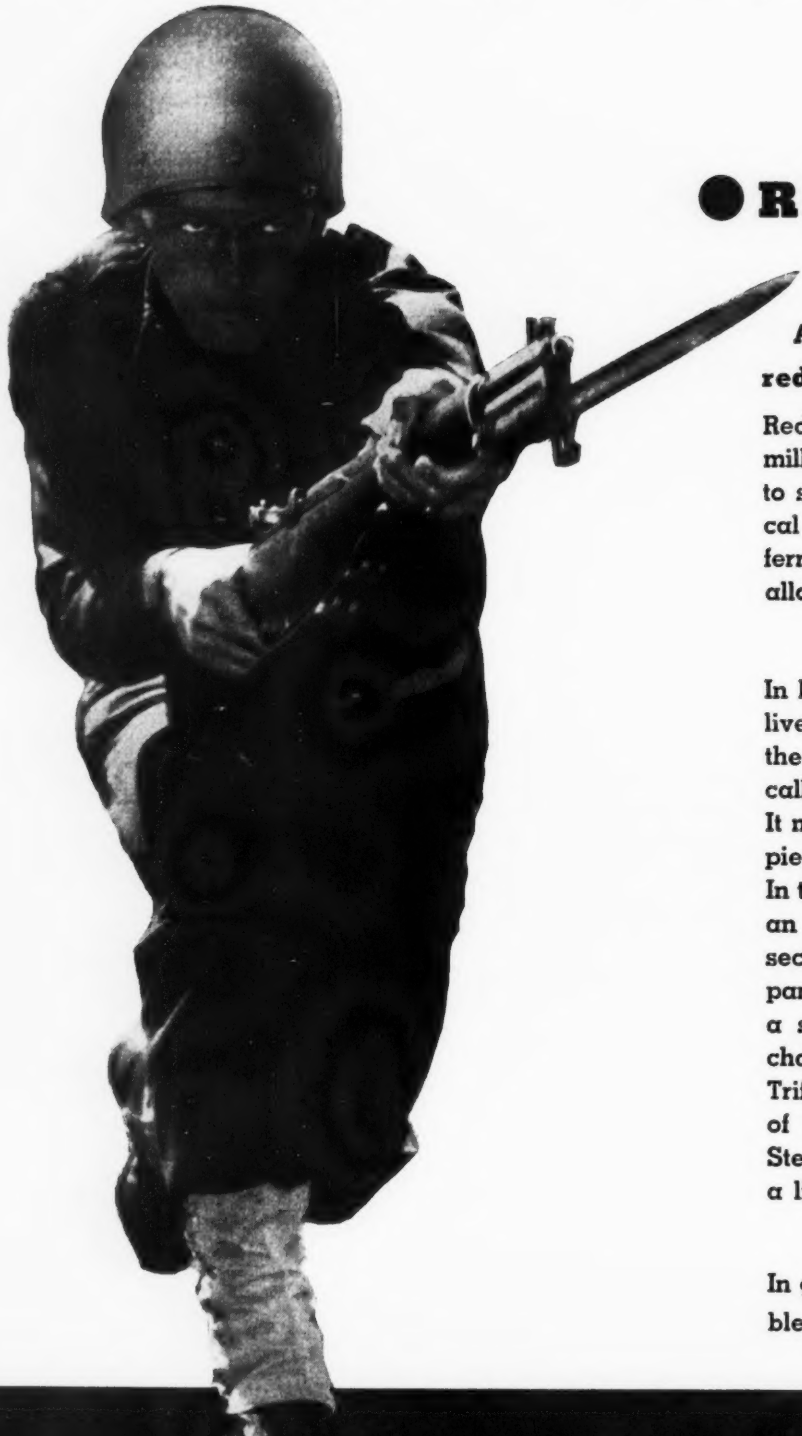
Armor Piercing Projectiles

Just across the hall is the division that must produce the projectiles which will pierce the enemy armor plate. These projectiles must have what it takes to pierce and plow through the best that is erected against them, and then do the maximum damage on the other side. That puts a real job up to the metallurgist. But here again he has faced the Metalurgency and in the short span of three months, on two sizes alone, the monthly savings are 90 Tons of Nickel and 20 Tons of Chromium, and they hit even harder and more effectively.

Induction Heat Treatment

Induction heat treatment has been used with major success by the Automotive Industry and therefore it is logical to see this process credited with a substantial share of the conservation record in the manufacture of the automobile's gruesome cousin, the tank. Our Chromium and Molybdenum supplies are the chief beneficiaries of Induction Heat Treatment in a multitude of Tank parts.





REDESIGN

As pointed out in "Tremendous Trifles", redesign is a big conservation factor.

Redesign affects many comparatively small parts, millions of which are required. But in addition to saving hundreds of tons of material and critical machine hours, redesign is saving critical ferro-alloys by making possible the use of low alloy or carbon steels.

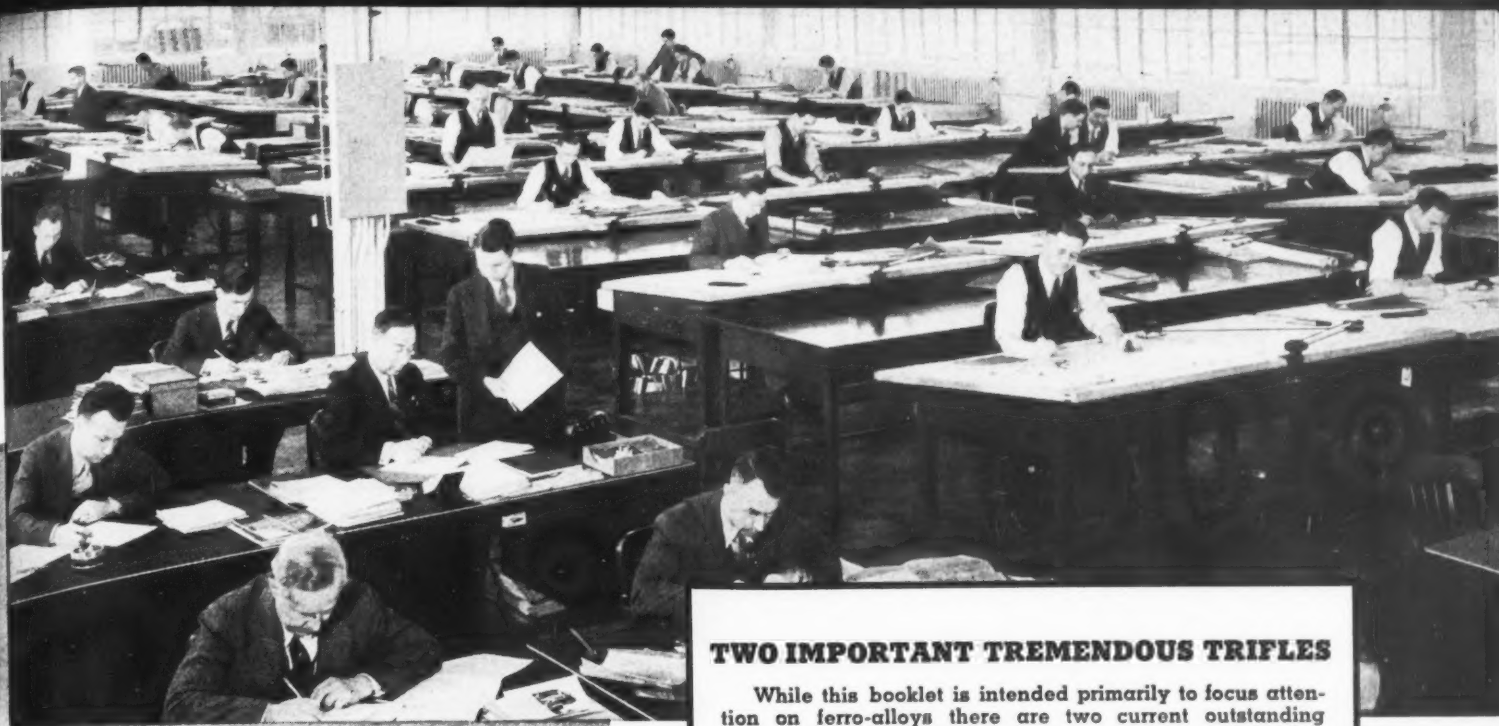
That Trifle - The Bayonet

In literally millions of hand to hand combats, the lives of soldiers, sailors and marines depend on the qualities of that "persuader" on the gun end called the Bayonet. It must be strong and tough. It must go where it is sent and come back in one piece.

In the program of improvement the designer, with an eye to conservation, found that when a certain section was made slightly heavier, and another part was changed to permit higher heat treating, a saving of 10,000 lbs. of Chromium could be chalked up in one year on this "Tremendous Trifle" by using W. D. 1080 Carbon Steel in place of W. D. 5090 a Special High Carbon Chrome Steel. This new steel in a soldier's hands is even a little colder than before.

Heavier Design

In general, making a weapon heavier is undesirable, and is not conservation, but when the added



weight is needed for strength and is small, and the saving of precious alloys is great, it is a happy combination. So when the shotgun barrel was thickened from .040 to .083 to provide sidewall thickness for tapping to attach a device, it permitted a change from Molybdenum Steel to low carbon steel.

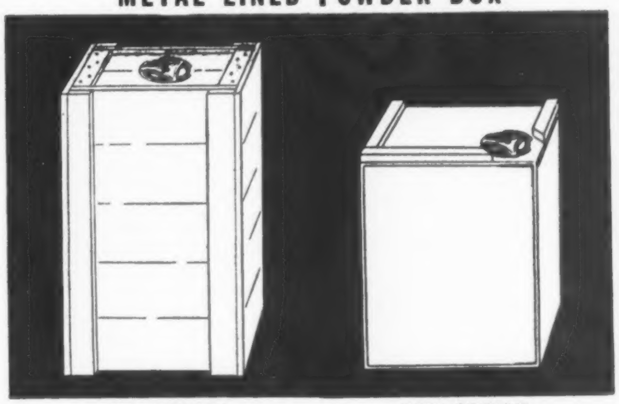
Stationary Gear Carrier

This stationary Gear Carrier, a small part, is another "Tremendous Trifle" where redesign contributed both to a saving in machine hours and critical ferro-alloys. It was formerly machined from solid stainless steel. Now it is stamped out of carbon steel and cadmium plated.

TWO IMPORTANT TREMENDOUS TRIFLES

While this booklet is intended primarily to focus attention on ferro-alloys there are two current outstanding examples of weight and critical material savings that should be mentioned now.

METAL LINED POWDER BOX



OLD DESIGN NEW DESIGN

The new design with equal useful volume shows a saving per month of 732,800 lbs. of Copper, 2,320 lbs. of Tin, 67,860 cu. ft. of Shipping Space and 1,508,000 lbs. of Shipping Weight.

BOMB FIN CRATE

OLD DESIGN NEW DESIGN

By embossing the steel members it was possible to lighten the gauge and reduce their size so that on current production a total of TEN THOUSAND TONS of steel per year will be saved on the 250 lb. size alone.

This design also uses the new stamped steel clip to replace the lock nut assembly described in Tremendous Trifles.

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

REVIEW OF SPECIFICATIONS

● Curiosity is a great attribute in a conservation program, but in the rush of war it is hard to find time to indulge in it.

Kipling or some other sage once said:

> "I have six honest serving men,
> I've found them tried and true;
> They're WHAT and WHY and WHEN,
> And WHERE and HOW and WHO."

You can see these "serving men" running all through both Army Ordnance and Industry and they are producing results. Scarce ferro-alloys are being saved daily by the mere review of specifications to see what can be saved, where it can be saved, how it can be saved, and who can save it.

This curiosity has resulted in the saving of 600 lbs. of Chromium per month in the comparatively small item of a calibre .45 Pistol Barrel. It simply wasn't needed.

In the Springfield Rifle bolt and receiver, N. E. Steel W. D. 8620 (N. E. 8620 Steel) was gone one better by adopting W. D. 8620 "Special" which contains only ½ the Chromium and ⅔ of the Nickel.

Necessity

Chromium and Vanadium have long been used in springs for their fatigue resisting qualities. Again, following the Automotive lead W. D. 9260 Silicon Manganese Steel is doing the job in Tank springs because specifications were reviewed with the Metalurgency in mind.

Persistence

Many ideas are developed in war and in peace which are ahead of their time. Some are allowed to die, but the originators or developers of others stick to them until their day arrives or until resistance to them is finally overcome. Many of the conservation steps recorded in Army Ordnance are old ideas that have been kept alive by the persistence of their originators. One that has been rattling around for fifteen years now holds the center of the stage in Army Ordnance but it is too potent and too secret to be revealed.

The point is that Army Ordnance recommends to Ordnance and to Industry that minds and files be searched for all ideas that have been mislaid or forgotten or which were ahead of their time.

RAISE THE PRODUCTION CEILING

The Metalurgency may be summed up as follows: If ferro-alloy specifications read today as they did two years ago, we would have already reached our Production Ceiling, because there isn't enough Nickel, Chromium, Molybdenum, Vanadium, Silicon and Manganese to build our war machine that way. But they do not read that way and we have not reached our production ceiling.

If a year from today our alloy specifications read as they do today, we will have reached our production ceiling. But they will not read that way and the ceiling will not have been reached.

This is not idle optimism. This is a statement of fact and if you will pardon an emotion that was too fast disappearing from our civilization until this war came on:

"Somebody said that it couldn't be done,
But he with a chuckle replied,
That maybe it couldn't but he would be one,
Who wouldn't say so 'till he tried.
So he buckled right in with a bit of a grin
On his face, if he worried he hid it.
He started to sing as he tackled the thing
That couldn't be done—and he did it."

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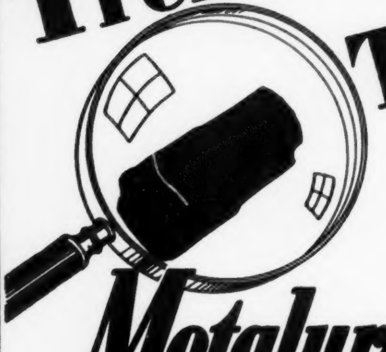
Tremendous Trifles



Metalurgency

FOR FURTHER INFORMATION

· Address ·

MAJOR GENERAL T. J. HAYES

ORDNANCE DEPARTMENT

U. S. ARMY

PENTAGON BUILDING

WASHINGTON, D. C.

Keeping Arc-Welding Sets up to Wartime Efficiency

Arc-welding a Huge Motor Frame

Long Hours of Continuous Operation on War Production, Severe Duty Requirements and Emergency Overloading are All Factors that Make Arc-Welding Set Maintenance of Prime Importance Today. Here are Some Helpful Suggestions

By R. F. WYER, Welding Engineer
General Electric Co., Schenectady, N. Y.

ARC-WELDING sets, along with almost every other kind of war production equipment today, are being subjected to severe service demands. It is necessary that they be immediately available for duty when wanted and that they be able to continue operating on a job as long as required. In some cases, an emergency may result in their use for heavier duty than that for which they were originally intended. Consequently an adequate maintenance program is more essential than ever to keep these machines as close to first-class operating condition as possible.

Where new sets are to be purchased, it should be kept in mind that the proper selection of equipment is actually the first step in adequate maintenance. To insure proper choice of the rating of a single-operator set, the maximum current, load voltage, and duty factor (ratio of arc time to total time) must be taken into account. Except in the smallest sizes, most sets are rated on a one-hour load. Their rating is the current they will deliver continuously for one hour without exceeding a prescribed temperature rise.

Since this method of rating does not take into account actual operating conditions, it is not always economically sound to choose the size

having a current rating next larger than the maximum operating current contemplated. This may result in the selection of too large a machine. On the other hand, the duty factor should also be taken into account to make certain that the set under consideration is big enough for the job.

Factors to Check in Installation

Proper installation can do much to keep the welding equipment at work and reduce troubles to a minimum. In wiring up a welding set, care should be taken to provide adequate branch circuit conductors and fuse clips large enough to accommodate the necessary fuses. Motor-generator type welding equipment units have full-voltage motor starters, almost without exception, so that due consideration must be given to taking care of the starting current of the motors.

Care should also be taken to ground the frames of all welding equipment, in order to avoid shock or annoying tickles caused by stray currents grounding when a person touches the frame of the equipment. Even though ungrounded equipment is in perfect operating condition, it is possible to receive a harmless but irritating sensation of shock from the passage of infinitesimal capacity or leakage currents through the body. In addition to providing protection against this annoyance, adequate grounding of machine frames is also a desirable safety precaution against harm resulting from insulation failure in equipment or leads, or from improper connections.

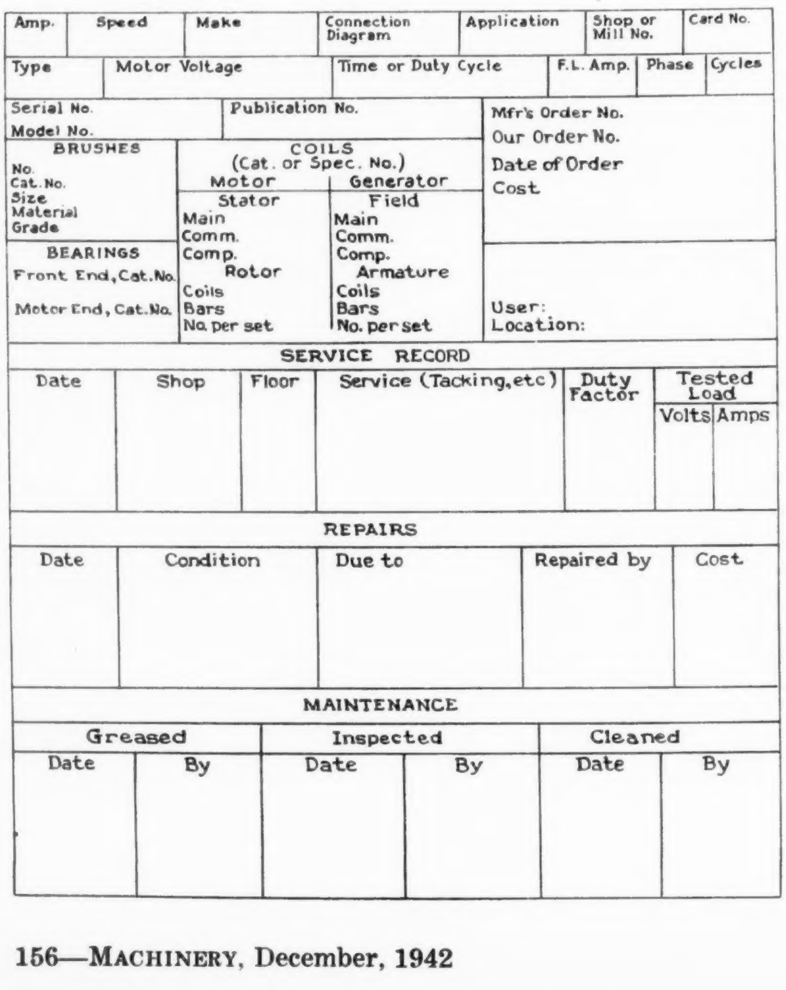
Regardless of the type of safety ground connection installed, adequate low-resistance work leads should always be used, and care should be taken to secure good connection between the work lead and the work. If this is not done, it is possible, under some circumstances, to overheat the safety ground connection by the passage of welding current through it.

In the location of welding equipment, ventilation is a very important consideration. The life of electrical insulation is seriously shortened by overheating, and overheating is bound to result where sufficient ventilation is not provided. Particularly where large numbers of welding equipment units are to be located in small enclosures, considerable study should be given to the problem of supplying clean, cool ventilating air.

Where small houses or temporary sheds are located in hot sunshine, the heat absorbed from the sun, added to the heat dissipated by the welding equipment, may raise the ambient temperature above 100 degrees F. and cause severe overheating. In such cases, large louvres or other ventilating openings should be provided in the building, not only at the bottom, but near the roof, to give good air circulation and to keep the ambient temperature below 100 degrees F. In some instances, it is desirable to provide exhaust fans to assist in removing heated air from the upper part of such enclosures.

The competent maintenance man will have a record of all welding sets under his care. One of the most useful and easy-to-handle references is a card file. All repair work, with its cost, can be entered on the record, and any welding set requiring excessive attention or expense can be investigated and the causes determined and corrected.

Inspection records will also serve as a guide to tell when a welding set should be replaced because of the high cost of keeping it in operating condition. Misapplications, abuses, and other unsatisfactory conditions will also be disclosed.


Amp. | Speed | Make | Connection Diagram | Application | Shop or Mill No. | Card No.
Type | Motor Voltage | Time or Duty Cycle | F.L. Amp. | Phase | Cycles
Serial No. | Model No. | Publication No. | Mfr's Order No. | Our Order No. | Date of Order | Cost
BRUSHES: No. | Cat. No. | Size | Material | Grade
COILS (Cat. or Spec. No.)
Motor: Stator — Main, Comm., Comp.; Rotor — Coils, Bars, No. per set
Generator: Field — Main, Comm., Comp.; Armature — Coils, Bars, No. per set
BEARINGS: Front End, Cat. No. | Motor End, Cat. No.
User: | Location:
SERVICE RECORD
Date | Shop | Floor | Service (Tacking, etc.) | Duty Factor | Tested Load: Volts, Amps
REPAIRS
Date | Condition | Due to | Repaired by | Cost
MAINTENANCE
Greased: Date, By | Inspected: Date, By | Cleaned: Date, By

Card Records of Every Welding Set in the Plant Save Time and Money. Records Made after Inspection and Servicing Show if Any Unit Requires Excessive Expense and Aid in Locating Hidden Faults before an Emergency Occurs

Sanding Brushes to a Good Fit with the Commutator is Essential whenever New Brushes are Installed on a Welding Machine Generator

A systematic and periodic inspection of motors and generators is necessary to insure best operation. While some welders are installed where conditions are ideal—with no appreciable dust, dirt, or moisture present—most machines are located where some sort of dirt accumulates on the windings. This lowers insulation resistance and cuts down creepage distances.

Steel-mill dusts are usually highly conductive, if not abrasive, and lessen creepage distances. Other dusts are highly abrasive, and actually cut the insulation as they are carried through by the ventilating air. Fine cast-iron dust quickly penetrates most insulating materials. If conditions are extremely severe, weekly inspection and partial cleaning are desirable. Most motors require a complete overhauling and thorough cleaning about once a year.

In the weekly cleaning, the motor and generator should be blown out with dry compressed air (about 25 to 30 pounds per square inch pressure). Where conducting and abrasive dusts are present, even lower pressure may be necessary, and suction is to be preferred, as damage can easily be caused by blowing the dust and metal chips into the insulation. On most motors the windings are fairly accessible, however, and the air can be properly directed to prevent such damage.

About once a year, welders should be overhauled. First, the heavy dirt and grease should be removed with a heavy, stiff brush, wooden or fiber scrapers, and cloths. Rifle-cleaning bristle brushes can be used in air ducts. Dry dust and dirt can be blown off, using dry compressed air at moderate pressure. Care must be taken to direct the air so that the dust will not cause damage and will not be pocketed in corners. Grease, oil, and sticky dirt are easily removed with cleaning liquids, such as carbon tetrachloride.

If the welder can be spared from service long enough, the insulation of the motor should be dried out by heating it to from 90 to 100 degrees C. While the motor is still warm, a high-grade insulating varnish should be applied.

The varnish may be sprayed or brushed on. After applying it, the best results are obtained by baking for six to seven hours at about 100 degrees C. If the machine must be put back into service quickly, or if facilities are not available for baking, fairly good results will be obtained by applying one of the varnishes that dry in a few hours at ordinary room temperatures.

Lubrication of Bearings

Manufacturers' instructions regarding lubrication of bearings should be carefully noted. These instructions should be kept near the welder, so that they are readily accessible. Usually, grease-packed bearings have sufficient lubricant when shipped from the factory to last about a year under normal conditions of cleanliness and temperature. When sets are operated in unusually dirty atmospheres, run continuously twenty-four hours per day, or are exposed to extremes of temperature, it would be well to

shorten the bearing inspection and lubrication interval to six months, or less if experience warrants. An occasional check of bearing temperature by feeling with the hand may disclose undue heating before damage is actually done. Once a lubricating routine has been established, it should be carried out, and by reliable men, who will follow instructions.

It is pretty generally established that outside of gross neglect for long periods of time, the major causes of bearing troubles are overgreasing and dirt. Overgreasing results in excessive heating of the bearing, frequently with churning and breaking down of the grease and consequent loss of its protective qualities.

Dirt occasionally gets into a bearing through the use of grease that is carried around or stored in uncovered containers. Quite as frequently it gets in through carelessness in protecting parts while bearings are disassembled or opened for inspection. The prevention is obvious, but often overlooked:

1. Every part of a bearing assembly, including retainer plates, gaskets, and screws, should be placed in a clean box immediately on removal, and if dropped or otherwise soiled, should not be replaced without a thorough cleaning in a suitable solvent.

2. None but clean hands, tools, and rags should ever be allowed to touch a bearing.

3. Grease *must* be clean. If there is the slightest doubt of its purity, it should be thrown away. Grease is cheap, compared with bearings and lost man-hours. Only a high grade of grease should be used for ball-bearing lubrication.

Keeping Generator Brushes in Condition

Brush inspection is important. The first essential for the satisfactory operation of brushes is the free movement of the brushes in their holders. Uniform brush pressure also is necessary to assure equal current distribution. Adjustment of brush-holders should be set so that the face of the holder is approximately 1/8 inch up from the commutator; any distance greater than 1/8 inch may cause the brushes to wedge, resulting in chattering and excessive sparking.

It is essential that the correct grade of brush for a specific application be used. Recommendations as to the correct grade of brush should be obtained only from the manufacturer of the welder.

Broken brushes may be due to two factors—incorrect brush or grade, or mechanical defects (such as unbalanced, rough, or eccentric commutator). To eliminate brush breakage, both factors should be corrected.

Check the brushes to make sure that they will not wear down too far before the next inspection. Have extra sets of brushes available, so that replacement can be made when needed. It is false economy to use brushes down to the absolute minimum length before replacement. Cases have been known where brushes have worn down until the metal where the pigtail connects with the brush was touching the commutator. This, of course, was causing damage to the commutator.

Make sure that each brush surface in contact with the commutator has the polished finish that indicates good contact, and that the polish covers all of the surface of the brush. In replacing a brush, be sure to put it in the same brush-holder and in its original position. It has been found helpful to scratch a mark on one side of the brush when removing it, so that it will be replaced properly.

In installing new brushes, fit them carefully to the commutator. Sand only until the curve of the brushes is the same as that of the commutator. Be sure that the brush shunts (pigtails) are fastened securely, so that current will not overheat the brushes and brush-holders.

Check the springs that hold the brushes against the commutator. Improper spring pressure may lead to commutator wear and excessive sparking. Excessive heating may have annealed the springs, in which case they should be replaced and the cause of heating corrected.

Generator Commutator Inspection is Important

Inspect the commutator for color and condition. It should be clean, smooth, and glossy, with a color varying from straw to chocolate brown where the brushes ride on it. A bluish or reddish color indicates overheating of the commutator. Roughness of the commutator should be removed by sandpapering or stoning. Never use emery cloth or an emery stone. Use a fine stone or No. 00 sandpaper unless the commutator is in bad condition, when the job may be started with a coarse stone and finished with a fine one.

For this operation, press the stone or sandpaper against the commutator with moderate pressure while the motor is running, and move it back and forth across the commutator surface. Take care not to come in contact with live parts. Be sure to keep the abrasive dust out of the machine.

If the commutator is very rough, as evidenced by pronounced up and down vibration of the brushes, the armature should be taken out and the commutator turned down in a lathe. When this is done, it is usually necessary also to cut back the insulation between the commutator bars slightly. If the commutator is found to be dirty when the generator is inspected, it should be wiped clean with a piece of canvas or other cloth that is free from lint.

Never put oil on the commutator. Proper

selection of brushes gives the commutator all the lubrication required to prevent excessive wear and to build up a good smooth-operating glazed surface on the copper. The addition of oil results in the development of a high resistance film, which may cause undue heating and rough brush action. The oil will also have a detrimental effect on the internal parts of the commutator.

Transformers Need Attention Also

The arc-welding transformers of alternating-current welders require a minimum of maintenance, but this fact should not be allowed to result in neglect. On fan-cooled units, fans should be cleaned and lubricated about once a year. Windings should be blown out at least twice a year in very clean locations, and more often in dusty places. At the time of this periodic attention, all connections and coil supports should be checked for tightness.

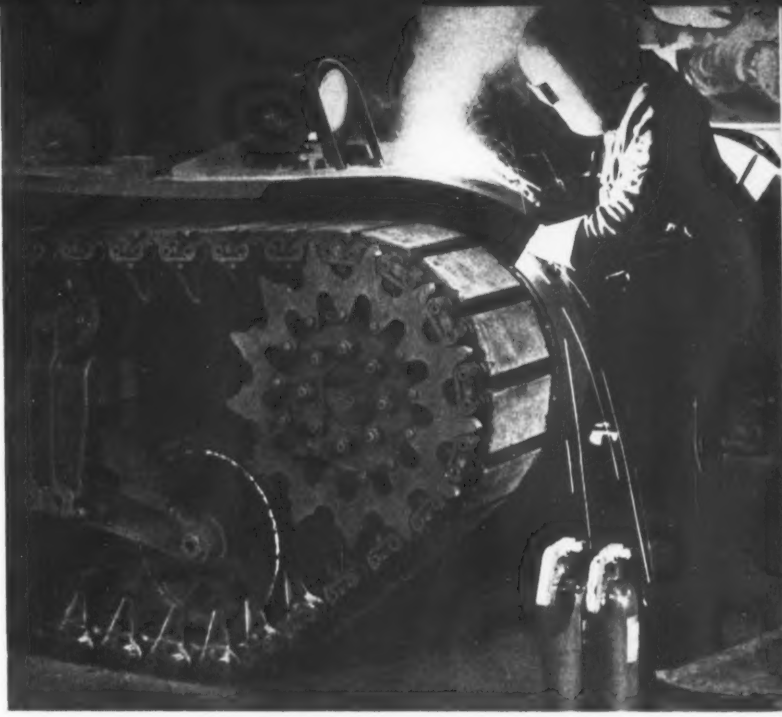
Manual current adjusting mechanisms should be lubricated often enough to prevent stiff operation of the handwheel or crank, making sure that a grease having a fairly high melting point is uniformly distributed over the full length of screws and guides. On motor-operated controls, lubrication at more frequent intervals may be required, as evidenced by slowing down of the motor or noise from the gearing. This point should be checked at least three times a year, and more often if experience justifies it.

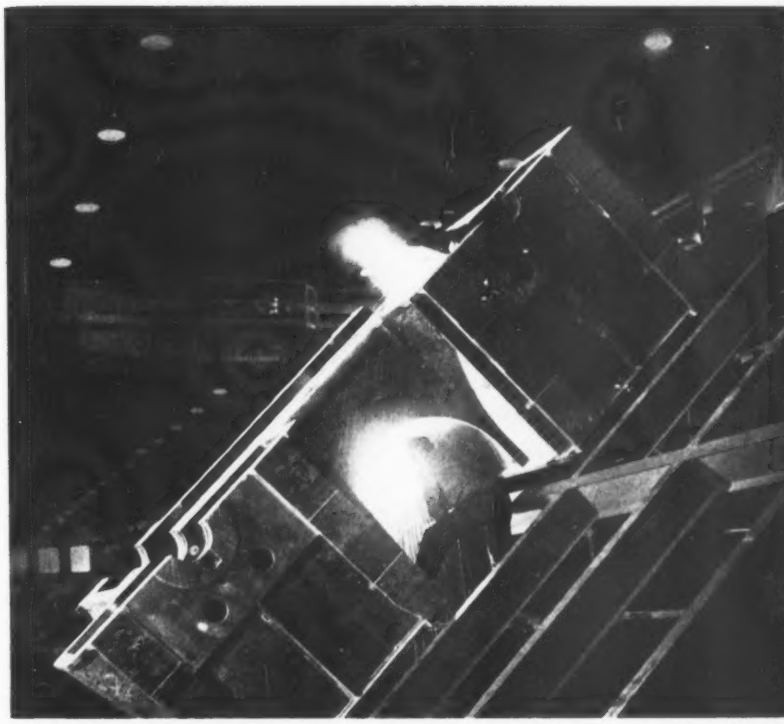
Abuses that Cause Trouble

While most welding equipment is designed to stand up under unusually adverse operating conditions, some not infrequent circumstances will cause serious impairment, if not complete interruption, of their service.

One bad practice, for example, is that of leaving weather-protecting tarpaulins thrown over machines in operation, in such a way as to interfere with the free passage of ventilating air into and out of the equipment. Cases are known where welders have been equipped with canvas flaps permanently installed on inlet and exhaust air openings, resulting in severe overheating and very short equipment life.

Improper connection of extension leads for either the electrode or the work terminals is not at all uncommon. This results in a high resistance circuit from welder to arc and return, with resulting variations in welding current, partic-





On Land, on Sea, and in the Air Arc Welding Plays a Vital Role. (Top) A Final Operation being Performed on a Medium-sized Tank. (Center) Welding a Huge Gear-case for a Merchant Ship. (Bottom) Airplane Motor Mount being Fabricated by Arc Welding

Arc-Welding Set "Trouble-Shooting" Chart

TROUBLE	CAUSES	WHAT TO DO
Machine fails to hold heat.	Rough or dirty commutator.	Commutator should be trued or cleaned.
	Brushes may be worn down to limit of adjustment or life.	Replace or readjust brushes.
	Brush springs may have lost adjustment or may be broken.	Replace or readjust brush springs.
	Field circuit may have variable resistance connection or intermittent open circuit.	Check field current with ammeter to discover varying current. This applies to both the main generator and exciter if used.
	Electrode lead or work lead connections may be poor.	Tighten all connections.
	Wrong grade of brushes may have been installed on generator.	Check with manufacturer's recommendations.
	Field rheostat or tap switches may be making poor contact and overheating.	Inspect rheostat and clean and adjust finger tension on switches.
	Brush-shifting or other mechanical current-adjusting mechanism may have loose or worn links.	Check current-adjusting mechanism for backlash and play.
Motor trips off line.	Power circuit may be single-phased.	Check for one blown fuse or dead line.
	Welder may be operating above current capacity.	Check load against welder nameplate. Check duty cycle.
	Welding electrode or work leads may be too long or too small in cross-section.	Check terminal voltage while machine is loaded; it should not exceed 30 volts on small machines or 40 volts on large machines when operating at rated current.
	Ambient temperature may be too high.	Make sure that temperature in motor-generator room or housing does not exceed 100 degrees F., and that there is no interference with normal ventilation of the machine.
Machine fails to start.	Power circuit may be completely dead.	Look for open disconnect switch, fuses removed from clips, or blown fuses.
	Power circuit may be single-phased.	Look for one blown fuse or one dead line.
	Power-line voltage may not be suitable for motor, or may be extremely low; may be accompanied by chattering of the motor starter.	Check voltage with voltmeter, particularly at the moment of attempted starting.
	Machine may be jammed.	See that armature turns over easily by hand, and look for foreign material in air gaps.
	Motor starter may be single-phased.	Check to see that all fingers on starter make contact when closed.
	Overload protecting relays may be tripped.	See that relay contacts are closed and that starter picks up when push-button is pressed. Be sure to remove cause of tripping.
Welder starts, but fails to generate.	May be running the wrong way.	Check direction of rotation with manufacturer's instructions or direction arrow. On three-phase motors, direction of rotation may be changed by interchanging any two leads.
	Generator or exciter brushes may be loose or missing.	Be sure that all brushes bear on the commutator and have proper spring tension.
	Exciter may not be operating.	Check exciter output voltage with voltmeter or lamp.
	Field circuit of generator or exciter may be open.	Check for open circuits in rheostat, field leads, and field coils. Also check resistors and rectifiers, if any. Some machines give low output when fields are open.
	Generator may be reversed in polarity due to another machine or incorrect operation in parallel with another machine.	*Flash the field with a storage battery or another generator, first with one polarity and then with the other to see if it "builds up." (Flash exciter field, if set has separate exciter.)
	Series field and armature circuit may be open-circuited.	Check circuit with ringer or voltmeter.
Welding arc is loud and spatters excessively.	Current setting may be too high.	Check setting and current output with ammeter.
	Polarity may be wrong.	Check polarity. Try reversing polarity or try an electrode of the opposite polarity.

*"Flashing" the field of a generator or exciter is a method of establishing the residual magnetism of the field structure with the proper polarity to cause the machine to "build up," or generate voltage. It consists of passing a relatively heavy current through the field windings momentarily, using an external source of direct current to supply the power. If a low-voltage source, such as a storage battery, is used, the series field of the generator should be flashed; if a higher voltage source, such as another generator or exciter is used, the shunt field should be flashed.

ularly when the leads are moved so as to change the resistance of the connections.

This is a frequent cause of complaints that the heat is not steady. The remedy for this is to make sure that connections are kept tight, and that all connections are made with cables equipped with properly installed cable lugs or terminals. It is practically impossible to bolt or wedge untinned flexible cable to another conductor and secure a good low-resistance joint. Soldered or reliable solderless connectors or terminals should always be used.

The use of excessively long electrode or work leads with motor-generator type welders will result in overheating of the motor when operating in the upper part of the current range, unless extraordinarily large cables, or a number connected in parallel, are used. Overheating of the motor from this cause is a frequent reason for motor-generator welders tripping off the line, with loss of production.

A source of trouble that is not guarded against by the motor overload relays is the intentional or unintentional application of long continued short circuits on the generator. Poor cable or cable connection insulation may cause short-circuiting of a generator for long periods of time. This results in the flow of very heavy generator current, but because of the low generator voltage involved, does not require sufficient power input from the line to cause the motor overload relay to trip. While the motor is not damaged, the generator may be seriously overheated or burned out. The same results will follow intentional permanent short-circuiting of the electrode-holder on the work or any grounded conductors.

The use of improperly bonded structural steel systems or building frameworks for the welding current return circuit is undesirable. The high resistance path thus afforded the welding current may result in overheating of the welder motor, and in addition, there is the possibility that arcing or overheating of some poor connection, possibly remote from the scene of operations, may go unnoticed and start a fire.

No attempt should be made to adjust welding current output by any means other than those provided and recommended by the manufacturer of the equipment. Shifting the brushes on generators not designed for brush-shifting control will usually result in inferior welding characteristics, impaired commutation, and short brush life. Short-circuiting of resistors or rheostats or any other tampering with the control furnished on arc-welding equipment may result in damaging or burning out the equipment.

Blowing Dust out of Welding Machine Motor should be Done Carefully with Low-pressure Air to Avoid Driving Abrasive Dust into Installation

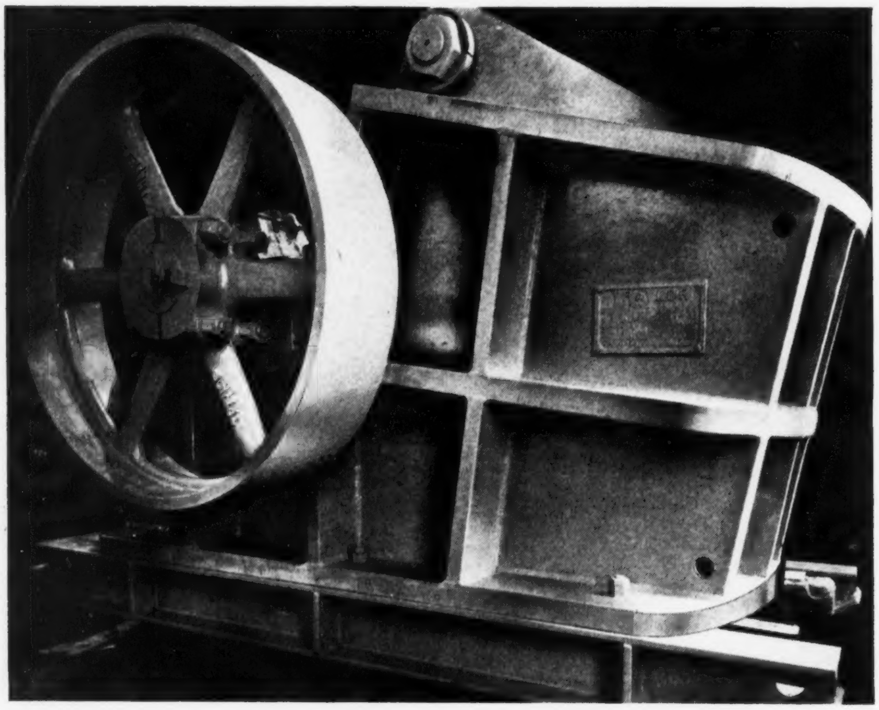
In transporting welding equipment, rough handling resulting in permanent mechanical damage is all too frequent. Motor-generator sets mounted on steel-wheeled running gear should be moved only at slow speeds—never behind fast-moving trucks or other vehicles. They should be eased over obstacles and depressions, such as flange clearance grooves in tracks. Slings used for transportation of welders by crane should be carefully arranged to avoid damaging control boxes, handles, and other equipment that is mounted on the outside of the set.

Care should be taken to avoid using arc welders out-of-doors in unfavorable weather. Many machines now on the market are semi-protected and drip-proof. This does not mean, however, that these welders should be used in rain without suitable protection. They can be operated out-of-doors, provided they are protected by tarpaulins or temporary shelters.

In spite of the reliability of the modern arc welder, troubles will occur. The causes and remedies for the majority of such troubles are given in the accompanying Arc-Welding Set "Trouble-Shooting" Chart.

Capacity of Crusher Increased by Arc-Welded Construction

The accompanying illustration shows a large all-welded jaw crusher built by the Traylor Engineering & Mfg. Co., Allentown, Pa. This company has conducted experiments for some time for the purpose of comparing all-welded jaw crushers with those built according to older conventional designs. The tests have proved that all-welded crushers are superior to those of comparable size built by conventional methods in that they have greater strength and can be submitted to heavier usage without failure. Furthermore, the weight of the machine is reduced.



A 30- by 42-inch Traylor Jaw Crusher of All-welded Construction

It is also stated that, in addition to increased capacity, the crushed stone from the all-welded crushers averages only half the size of that from the old crushers. On the basis of the results of these experiments, therefore, the Traylor Engineering & Mfg. Co. has adopted welded steel construction as standard for this type of stone crusher. In the welding work, 600-ampere Lincoln welding machines and Lincoln electrodes are used.

* * *

In four months from the time work was begun, the National Tube Co. converted 137,500 tons of steel ingots into 24-inch pipe for the 550-mile oil-pipe line from Longview, Tex., to Norris City, Ill. It took 4600 gondola cars to ship the tubes.

Two-Hundredth Anniversary of Taylor-Wharton Iron & Steel Co.

This year the Taylor-Wharton Iron & Steel Co., High Bridge, N. J., celebrates the two-hundredth anniversary of its endeavors in the iron and steel industry, and the fiftieth anniversary of the making of Hadfield's manganese steel. The history of the company parallels that of the growth of this nation, from early colonial days to its present industrial position.

The Taylor-Wharton Iron & Steel Co. and its predecessors were not the first makers of iron in this country, and in all likelihood, the company is really older than the two-hundredth anniversary indicates; but it is definitely known that its production has been continuous for two hundred years, since this is borne out by documents on record since the days of the founders, Allen and Turner.

In 1742, Allen obtained 3000 acres of land adjacent to a forge already in existence. The ruins of this forge still stand on the Taylor-Wharton grounds. Allen immediately began to build a new furnace some distance away from the forge. The building of the furnace is recorded in the *Pennsylvania Journal* of January 11, 1743. From that time on, the company has been continually in business.

Expanded activities, however, were not possible until the building of the Jersey Central Railroad enabled the works to obtain anthracite coal and to bring iron ore from distant mines. Not only did the railroad provide transportation, but it also provided business for the works by buying rails, coupling links, car wheels, axles, and other railroad equipment.

A great contribution was made by the works in 1892, when the American rights for the manufacture of manganese steel, which had been developed by Robert Hadfield of England, were obtained. The present name of the organization was adopted in 1912, when it became the Taylor-Wharton Iron & Steel Co.

* * *

One large plant has scrapped over two thousand dies and jigs in the scrap campaign to provide steel-mill scrap iron.

MACHINERY'S DATA SHEETS 479 and 480

RECOMMENDED TOOL ANGLES, FEEDS, SPEEDS, ETC., FOR MACHINING WITH CEMENTED-CARBIDE TOOLS—1

Material	Brinell Hardness	Clearance, Degrees: Front Tool Angle	Clearance, Degrees: Side Tool Angle	Top Rake, Degrees	Depth of Cut, Inch: Roughing	Depth of Cut, Inch: Finishing	Feed, Inches per Rev.	Speed, Surface Feet per Min.: Roughing	Speed, Surface Feet per Min.: Finishing	Remarks
Aluminum	—	6–8	6–8	0	1/16	—	0.022	3000–4000	—	
Aluminum	—	6–8	6–8	0	—	0.012	0.016	—	5000–6000	Fine boring. Mirror finish
Aluminum Alloy (Hard)	—	4–5	4–5	—1	1/16–1/8	—	0.024	1000	—	
Aluminum Alloy (Hard)	—	4–5	4–5	—1	—	0.015	0.018	—	3200–4000	Fine boring
Aluminum (5½% Silicon)	—	4	4	—2	—	0.015	0.125	—	1000	
Aluminum (3½–5½% Silicon)	—	2	2	—4	1/16–1/8	0.008	0.020	2400	3600–4200	Mirror finish
Aluminum (Magnesium)	—	2–4	2–4	—4	1/8–3/16	0.020	0.032	2400	3600–6000	Mirror finish
Bakelite	—	4	4	—2	—	0.040	0.018	—	500–900	
Bakelite (Threading) ..	—	4	4	—4	—	—	—	600–800	—	Feed, start, 0.007"; finish, 0.002" per rev.
Brass (Common Yellow)	—	4–6	4–6	—2	1/8–3/16	0.032	0.024	1000–2400	2000–3600	
Brass (90–10)	—	4–6	4–6	0	1/16–1/8	0.010	0.020	3600	4000	Bench lathe
Brass (70–30)	—	4–6	4–6	0	1/16	—	0.022	3600	—	
Bronze (Soft)	—	5–7	5–7	0	1/8–3/16	0.015	0.022	750–1200	1500–1800	
Bronze (Phosphor) ...	—	4–6	4–6	0	1/8	—	0.022	750–1000	—	
Bronze (Manganese) ..	—	4	4	—2	1/8	0.010	0.022	750–1000	1200–1500	
Copper	—	5	5	0	1/8	—	0.022	750–1200	—	
Copper (Chipbreaker).	—	4	4	—2	3/16	—	0.022	750–900	—	
Chromium Plate (Hard)	—	5	4	—4	—	0.005	0.010	—	210	
Die-Block, Chromium-Nickel	180	2	2	—18	1⅛	—	1/32	100	—	Shaper, planer. Hardened

MACHINERY'S Data Sheet No. 479, December, 1942

Compiled by C. G. Williams, Consulting Engineer
Forged Carbides, Inc., Long Island City

RECOMMENDED TOOL ANGLES, FEEDS, SPEEDS, ETC., FOR MACHINING WITH CEMENTED-CARBIDE TOOLS—2

Material	Brinell Hardness	Clearance, Degrees: Front Tool Angle	Clearance, Degrees: Side Tool Angle	Top Rake, Degrees	Depth of Cut, Inch: Roughing	Depth of Cut, Inch: Finishing	Feed, Inches per Rev.	Speed, Surface Feet per Min.: Roughing	Speed, Surface Feet per Min.: Finishing	Remarks
Duronze I	—	4	4	0	1/8	—	0.020	300 +	—	One test only
Duronze II	—	4	4	—2	1/4	—	0.020	400 +	—	One test only
Duronze II	—	4	4	—2	—	0.008	0.010	—	400	Fine boring (16 pieces between grinds)
Duronze III	212	5–7	5–7	0	1/16–1/8	0.028	0.020	1000–2000	1400–1600	
Duronze III	212	5–7	5–7	0	3/16	—	0.022	750	—	
Duronze III	212	4	4	—4	3/8	—	0.020	600	—	
Inconel	—	4	4	0	—	0.032	0.020	—	1000	
Inconel	—	4	4	0	0.080	—	0.022	600–750	—	
Inconel	—	3	3	—3	0.125	—	0.024	500	—	
Iron, Alloy Cast	300	4	4	—4	up to 1/4	0.032	0.022	300–450	500	
Iron, Alloy Cast	300	4	4	—12	up to 1/2	—	0.028	100	—	Shaper and planer
Iron, Alloy Cast	300	4	4	—18	3/8	—	0.032	110	—	Shaper and planer
Iron, Gray Cast	200	4–7	4–7	0	up to 1/4	0.020	0.022	300–750	750	
Monel	—	3	3	0	—	0.008	0.012	—	2400	Mirror finish. Fine boring
Monel	—	3	3	—2	1/8	—	0.028	450–600	—	
Nickel	—	4	4	0	—	0.032	0.020	—	2000	
Nickel	—	4	4	0	—	0.015	0.020	—	2700	
Nickel	—	3	4	—2	1/8	—	0.022	450–600	—	
Nickel	—	3	4	—2	3/16	—	0.022	375–500	—	
Rubber, Hard	—	6–8	5–7	0	—	0.032	0.020	1000	—	

MACHINERY'S Data Sheet No. 480, December, 1942

Compiled by C. G. Williams, Consulting Engineer
Forged Carbides, Inc., Long Island City

Conservation of Critical Materials by Redesign

By J. B. NEALEY
Ordnance Department, Washington, D. C.

Approved for Publication by the War Department

THE Ordnance Department of the United States Army is responsible for the development, production, and procurement of all fighting weapons used by our soldiers, as well as those supplied by our Government to the other armies of the United Nations. This makes it the largest business in the world. After once designing the equipment or weapons, it is necessary to keep constantly abreast of changing manufacturing facilities and to effect improvements in design for better functioning or greater safety. In addition, there has recently been added another important requirement—that of reducing the use of critical materials without affecting military efficiency or safety.

Under peacetime conditions, the natural resources of this country include an abundance of raw materials of all kinds. The few that are not found here are available through foreign trade. However, the enormity of the production of fighting materiel is consuming more basic materials than were used for all peaceful purposes.

As a result of this suddenly increased demand, the country is now consuming materials as fast as they can be mined or produced, if not faster. The huge production machine built during the past year or two requires a constant stream of materials, and upon the balanced combination of the two depends the future of the United Nations.

Scarce or "Strategic" Materials

In the earlier days of this production program, the list of "strategic" materials was limited to magnesium, aluminum, nickel, and zinc; but as production increased, other metals and materials were added, one by one, until now there are but few exceptions. However, there are various degrees of the "strategic" or "critical" nature, and this relationship is constantly shifting. To maintain quality standards of all materiel, it is necessary that each of the critical materials be used in certain applications; to make them available for these uses, it is evident that they should not be used where their individual characteristics are not required or where a suitable substitute can be found.

A few years ago, the production of Army ordnance materiel was so limited in volume that the items were produced in the most expedient way. Hence, fuse components were made from aluminum bars or steel forgings, and machined parts were used instead of steel stampings, etc. This was done not because of lack of engineering experience, but rather because of the quantity limitations placed upon Ordnance engineers at that time. These conditions, coupled with the wasteful practices resulting from the past overabundance of all materials, made it necessary to inaugurate a strict conservation program.

Fortunately, the Ordnance Department foresaw the need for such a program; and long before the public was conscious of any shortages, a group of specialists and engineers was at work on this problem. Through extensive and intensive research, redesign, and testing, a great many items are now being made from more abundant materials or alloys, or from compositions in which the critical alloys have been eliminated or reduced. The progress made in this conversion is one of the highlights of the war.

What has been Accomplished in Changing from Formerly Used Materials

Conservation cannot be accomplished with conversation, committee actions, standardization programs, or simple specification changes. All of these play a part, of course, but the real objective can only be reached by the practical application of materials engineering. Conversion of materials into fighting materiel is a particularly difficult task, since safety and military requirements cannot be jeopardized. Failure of industrial machinery components may result in the loss of production and money; but failure in war materiel means a loss of life—perhaps the loss of a battle, or even a war.

Ordnance materiel is subjected to extensive testing, sometimes over a period of years; and once a design is established as correct, it is difficult—in some cases impossible—to change materials without the possibility of unsatisfactory functioning. For example, the design of ammunition components has been tested over many years of practice — in war maneuvers, and recently in actual combat.

The Ordnance Department has made hundreds of outstanding conversions, resulting in the saving of tremendous quantities of aluminum, nickel, chromium, vanadium, zinc, tin, rubber,

manila, textiles and many other basic materials. It is unfortunate that the most amazing changes and results cannot be told, because of their military value and importance. However, changes not involving secrecy are of great interest, although it is possible to mention but a few here.

The conversion of artillery cartridge cases from brass to steel is an achievement of the highest order. Other countries, lacking adequate supplies of copper and zinc, have worked on this problem for years. America, with an abundance of both, has done some experimental and development work on it in her arsenals for the last twenty years, but has never really seriously considered the problem until now. When necessity dictated, it was finally tackled in earnest by Ordnance and industrial engineers, and a highly satisfactory solution was arrived at in a few months. The Ordnance Department now has hundreds of millions of steel cartridge cases of all calibers on order, and it is planned to have all artillery cases converted to steel by the end of this year. This will result in a saving of 100,000,000 pounds of copper in 1942, and approximately 600,000,000 pounds in 1943.

The development of steel cases for small arms weapons, rifles, machine guns, etc., is progressing rapidly. Distinctly different manufacturing problems and the use of much higher powder pressures make the smaller cases a more difficult problem. An experimental production line for the manufacture of these cases is now in operation, and the development is progressing rapidly. It is believed that, in a few more months, a final and satisfactory solution will be found.

An Example of the Use of Die-Casting to Conserve Primary Aluminum

Another outstanding development is represented in the fuses of trench mortar shells. Two of the three parts, the body and head, were formerly screw machine parts made from aluminum bars, while the booster cup was die-cast from aluminum. Although aluminum of all qualities was scarce, there was considerable difference in the availability of primary wrought aluminum and that containing higher impurities or of secondary quality. Consequently, the first step was to produce and test all three parts made by die-casting from secondary aluminum. This resulted in the release of more than 35,000,000 pounds of primary aluminum for the production of aircraft or other essential uses.

Application of Plastics in Fuses

For two years or more, extensive research and study has been given to the possibility of using molded plastics for fuse components. Tests have indicated that existing plastics are not suitable for such applications in rifled-bore shell fuses. However, mortars are smooth-bored and of much lower muzzle velocity, which eliminates the rotational forces, and greatly reduces the set-back forces acting on the fuse. Development work in connection with the substitution of plastics for fuses was initiated a year or more ago, and after extensive testing of many varieties of plastics, a suitable composition was found. Thousands of rounds were then fired at the Proving Grounds to determine its safety and proper functioning.

Approximately three months ago, this thermosetting plastic was adopted, and already more than one-half the number of fuses of one type are being made from it; additional quantities will be made from it as fast as the plastic molds become available. The change from aluminum machined parts to die-castings saved primary aluminum for aircraft construction, while the recent conversion from die-castings to plastics conserves the secondary quality for one type of fuse, fire control instruments, etc.

Efforts to Conserve Tin

Long before Pearl Harbor, the Ordnance Department had initiated methods to reduce the quantity of tin required for ordnance materiel; events in the Far East have justified the early action in conserving this vital metal. The most interesting substitution is not yet completed. This involves the replacement of soldered terneplate boxes in which belt ammunition for machine guns is packed. In view of the climatic and other hazards of transporting ammunition, and the necessity for each round to function without jamming the gun, it can be appreciated why these containers must be moisture-proof, even after complete submersion in water. Also, this container must open easily to make the ammunition readily available to the machine gunner under the most adverse conditions. This is accomplished by a soldered "tear strip" along one face of the container, functioning much like that on a metal coffee can, except that it must tear without the use of a time-consuming tool.

The solder formerly used for this tear strip was composed of 70 per cent tin, and now contains but 50 per cent. It is of interest to note that counter-conservation measures were required in this instance. Criticisms of the use of such tin solder have been made, but the need for accessibility of the ammunition for the self-protection of the machine gunner made the Ordnance Department insist on its use. However, this is now a temporary use only, since a practical carton requiring no tin or other critical materials whatsoever has been developed, and will soon be in production. This will effect a saving of approximately 1,250,000 pounds of tin in 1943.

Solders for other applications have been changed to require a minimum of tin. Silver-lead solders are used to an increasing extent. Tin

bronzes have been replaced by silicon or aluminum bronzes, tin and terne plate have been almost entirely eliminated for use in containers, and tin has been eliminated or greatly reduced for several other uses. In all, the Ordnance Department expects to save a minimum of 12,000,000 pounds of tin in 1943.

Rubber—One of the Most Important of Scarce Materials

Conservation of rubber presents one of the hardest single problems in ordnance conservation because the modern war of movement rolls on rubber. Mobility requires millions of tires on fast moving armored vehicles and guns. To maintain this mobility on a competitive basis with the enemy, rubber must be eliminated or conserved in all other uses. This conservation must follow many lines of approach, mainly the finding of substitute materials or methods of accomplishing the same objective by redesign and by entirely eliminating the use of this critical material for all unessential applications. By day-to-day scrutiny, all rubber uses, large or small, in all branches of ordnance are being measured by the yardstick of necessity.

By saving rubber formerly used in tank cushions, more is available for tires and tubes to keep armored cars going. By changing over to steel treads on the relatively heavier and slower moving tanks, more is available for insulation in intricate fire-control apparatus. Rubber saved in crash pads helps keep ammunition dry, and the needs for the latter purpose have been drastically cut by reducing the amount of crude rubber in compounds, or by "down grading."

Along with saving or eliminating rubber in non-functional uses to have more available for mobility, further conservation has been effected in tires by engineering developments. Redesign of the wheel assembly eliminates the use of a rubber flap. The use of rayon to replace cotton in tires requires fewer pounds of crude rubber; thus, with increasing supplies of rayon, the rubber we now have will produce a greater quantity of tires.

This shifting around, as it were, of various raw materials is breaking many bottlenecks. It is a program of far-reaching results, and the Ordnance Department has originated and executed it with swiftness and efficiency.

* * *

The National Bureau of Standards has published a Commercial Standard for screw threads and tap drill sizes, designated CS24-43, which will be effective for new production February 10, 1943. Printed copies of this standard can be obtained on request from the National Bureau of Standards, Washington, D. C.

Results Obtained by Using Large Electrodes

The use of as large electrodes as possible in arc welding has been advocated in numerous items published previously in MACHINERY. The use of large electrodes is necessary if maximum production is to be obtained.

The Commercial Shearing & Stamping Co., Youngstown, Ohio, recently was presented with the Army-Navy "E" award for excellence in production. The company mentions that some of the arc-welding methods employed aided materially in the winning of this recognition, and the use of large electrodes was an important item in this connection.

As an example, it is mentioned that a 3/8-inch fillet weld in 1/2-inch mild steel plate, formerly welded with 1/4-inch electrodes at 40 feet per hour, is now welded with 3/8-inch electrodes at 95 feet per hour. In another case, a 1/4-inch fillet in a 3/16-inch plate, formerly welded with 3/16-inch electrodes at a rate of 8 inches per minute, is now welded with 1/4-inch rod at 14 inches per minute.

* * *

High-Speed Machining of Aluminum

According to the Automotive Council for War Production, a number of remarkable increases in speeds for cutting aluminum alloys have recently been recorded. In several cases, these speeds are from three to seven times higher than those used in conventional practice. For example, in one instance, aluminum alloys are milled at a surface speed of 7000 feet per minute, with a feed of 60 inches per minute. The operation is performed dry on a forging in which deep fins are cut. The milling cutter used is carbide-tipped and honed to a fine finish.

In another case, a cutting speed of 3500 feet per minute, with a feed of 80 inches per minute, is used. The depth of cut is 1 inch. An ample supply of coolant is employed. The aluminum alloy being cut is extruded No. 24-ST. The cutter blades are made from Tantung G, the blades being inserted in a malleable-iron body.

* * *

Machine Tool Handwheels and Knobs Made from Plastics

Handwheels and control knobs for machine tools are being made of plastic materials to conserve metals. Handwheels up to 12 inches in diameter, with a metal ring insert for keying to the shaft, are being made. These are strong enough for the purpose and resistant to the effects of oil, grease, and cutting compounds.

How Curtiss-Wright Produces Famous

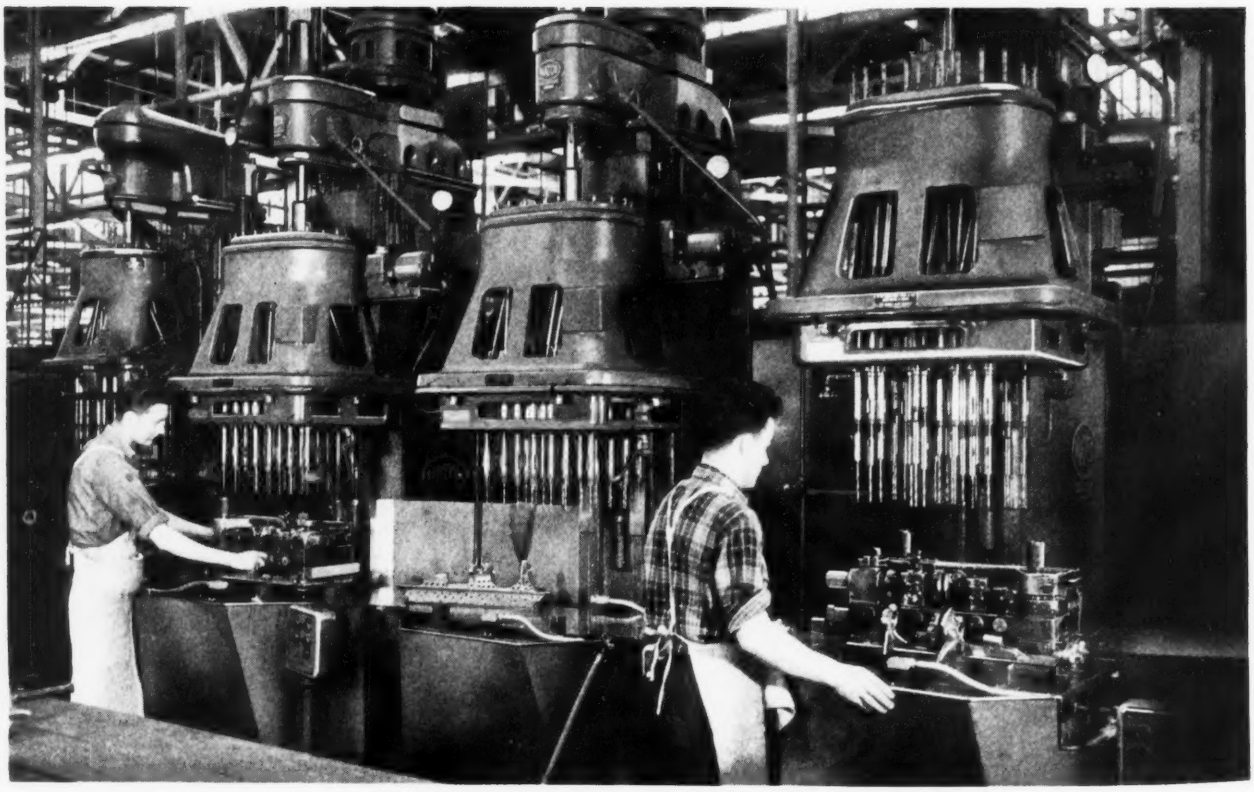
Some of the Production Methods Employed in Turning out the Noted Pursuit Planes of the P-40 Series, Popularly Known as Tomahawks, Kittyhawks, and Warhawks

A GENERAL outline of the high-production methods employed in turning out huge quantities of fighting planes in one of the factories of the Curtiss-Wright Corporation was presented in July MACHINERY. Several detail operations of an unusual character were also covered. The present installment will describe additional operations which have helped to increase production.

A unique drilling and reaming set-up insures close interchangeability of four landing-gear cluster fittings. Three of these pieces are placed on the ribs of a longer fourth member in the same location in which they will later be assembled together. Then the parts are accurately located in this manner in the jig and holes are drilled through both the individual parts and the long member on which they are seated. Four parts arranged on each other in the manner described may be seen at the front of the jig in Fig. 15.

While in this jig, the parts are drilled and reamed as the jig is transferred from station to station of the battery of four Natco multiple-spindle drilling machines shown in Fig. 14. The drills on each machine are arranged in two sets. At each machine, the jig is first pushed to the back of the table until two slotted locating blocks near the ends of the jig on the rear side engage solid locating blocks attached to the table. The jig is pushed back over these blocks until it makes contact with a Micro safety switch on the table, which operates a solenoid switch to permit the multiple-spindle drill head to descend. Unless the jig makes contact with the Micro switch, the machine cannot be operated. Locking fingers

Fig. 14. Four Multiple-spindle Drilling Machines Used in Drilling Sixty-eight Holes and Reaming Twenty of Them in the Landing-gear Cluster Fittings



Fighting Planes

By P. N. JANSEN, Director of Manufacturing
Airplane Division, Curtiss-Wright Corporation

Approved for Publication by the War Department

on brackets attached to the table near the front of the jig are swung upward across dowel-pins that extend from the ends of the jig to hold the jig down on the table when the drills are raised at the end of the operation.

The drill spindles on the rear half of the drill head only are used with the jig in the back position. Then the jig is pulled to the front of the table until its slotted locating blocks engage solid blocks at the front of the table, as seen in Fig. 15, and the jig makes contact with another Micro switch. By applying all the drilling machine units in this manner, sixty-eight holes are drilled and twenty of them are reamed, all within 0.001 inch of the specified center-to-center distances. The production averages ten times the output previously obtained with a single-spindle machine. Right- and left-hand pieces of the same kind are handled by the use of different jigs and by changing the cluster plates on the drilling machines.

All of the pieces handled in this operation are forged from nickel-chromium-molybdenum steel having a hardness of between 32 and 36 on the Rockwell C scale and a tensile strength of 150,000 pounds per square inch. The ribs of the long piece on which the other three pieces are positioned for drilling have a cross-section in the shape of a cross, except that the ribs are not exactly at right angles to each other. All four ribs are milled on both sides by means of Sundstrand milling machines, tooled up as shown in Fig. 16. One rib is milled on both sides and two others on the top side only when the work is positioned in the left-hand side of the fixture. Then, after the part has been transferred to the right-hand side of the fixture, the two middle ribs are milled on the second side and the remaining rib is milled. One piece is completed with each reciprocation of the table.

The part is approximately 18 inches long, and its finished surfaces must be straight within 0.005 inch. Stock to a depth of 1/16 inch is removed from each of the eight surfaces. The parts are quickly clamped in the fixture by tightening machine screws on each side. The clamping bars are serrated to increase their gripping action and prevent endwise movement of the workpieces.

In view of the many thousands of rivets that must be driven in building an airplane—approximately 70,000 on a Curtiss Warhawk—it is desirable to expedite riveting operations as much as possible. Multiple riveting is therefore employed in many sub-assembly operations, the machines in use being a type that is built by the General Engineering Co. The typical operation shown in Fig. 17 consists of driving ten flush-head rivets at a time through duralumin sheets that make up a wing section. When these units reach the machine, the rivets have been inserted through holes in the under sheet that are sufficiently tight to hold the rivets in place until the heads are driven on the upper side. Brazier-head rivets can also be driven on a multiple riveter by holding a cardboard on the rivet heads on which the ram descends. This procedure eliminates the need of employing accurate cup sets which engage the individual rivet heads during the multiple driving operation.

Automatic Chicago riveting machines, which both feed the rivets into the holes and drive the rivet heads, are shown in Fig. 18. This operation is being performed on wing webs, which are made up of a total of forty-five pieces, riveted together.

Much labor-saving equipment has been provided for the plane fabricating department. In Fig. 19, for example, is shown a trunnion jig de-

Fig. 15. Close-up View of Jig Used in Drilling and Reaming Four Landing-gear Cluster Fittings. Four Parts Assembled in the Position in which They are Held for the Operation are Seen in Front of the Jig

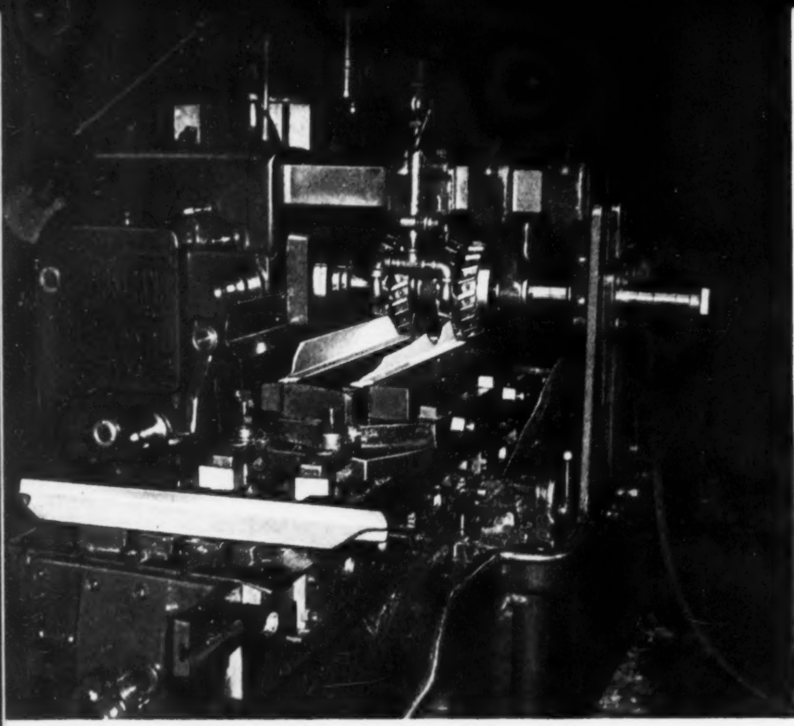


Fig. 16. Milling Machine Tooled up for Finishing Eight Surfaces on Nickel-chromium-molybdenum Steel Forgings that Must be Straight within 0.005 Inch in a Length of Eighteen Inches

signed for drilling over two hundred holes in match angles, which are long extruded shapes of duralumin used in fastening wings to the center section of the airplanes. The match angles are clamped to one side of a plate on this trunnion jig, and then the jig is turned through 180 degrees to enable drilling from the opposite side. Match angles of one hand are clamped on one side of the jig plate, and those of the opposite hand on the other side, it being possible to drill through the jig bushings from either side. The holes are drilled by Delta motor-driven drilling machines, attached to hinged arms that are mounted on structural carriages. The carriages run on rollers the full length of the jig.

Wherever two pieces of duralumin or a piece of duralumin and a piece of steel are assembled together, provision must be made to prevent corrosion due to electrolysis. This corrosion is prevented by coating all pieces of duralumin with zinc chromate. The coating of small and medium-sized pieces has been expedited by the installation of the unit shown in Fig. 20, which consists of a conveyor that has sixty-five racks, on which parts can be placed in vertical or horizontal positions. Workmen standing at the front of the conveyor dip the parts into a tank of zinc chromate which extends along the front of the installation, and then place the parts on the racks as they pass by. The work-pieces are taken from tote boxes, brought to adjacent tables. After the racks pass from the loading stations, they enter a tunnel which is provided with an overhead blower system. The circulating air in this tunnel dries all parts by the time they reach the unloading station seen at the left. It takes nine minutes for a rack to be carried completely around the conveyor. Inspectors check the coated work before it is taken to assembling operations.

Paint spraying booths of various types are located in and adjacent to assembly lines for the performance of painting on a production basis.

Fig. 17. (Center) Multiple Riveting is Employed to a Considerable Extent to Speed up Sub-assembly Operations

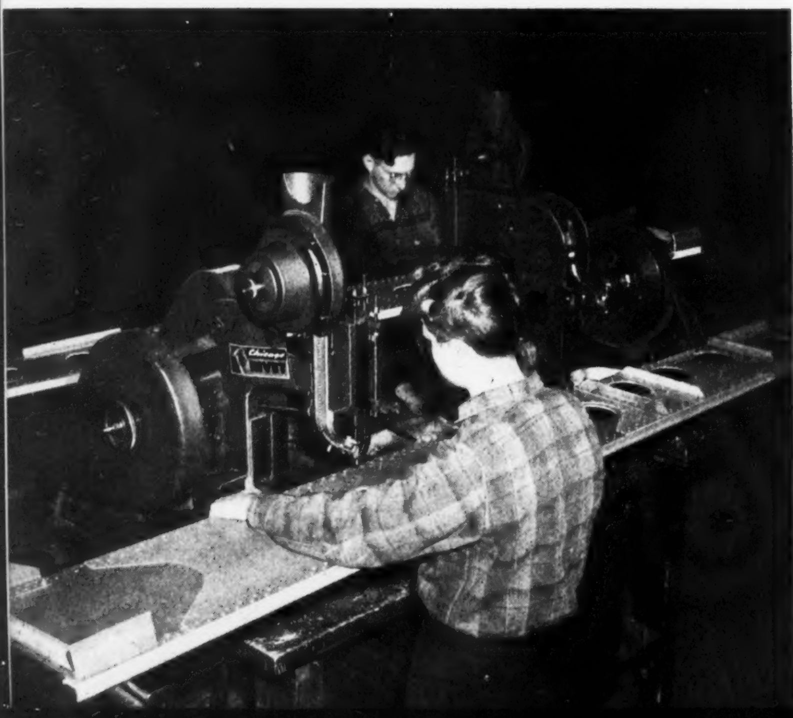


Fig. 18. (Left) Automatic Riveting Machines which Feed the Rivets from a Magazine and then Drive the Heads

Fig. 19. Trunnion Jig Designed for Drilling over Two Hundred Holes in Match Angles. The Work is Clamped on One Side of the Jig and Drilled from the Opposite Side after the Jig has been Indexed

Huge booths, such as seen in Fig. 21, are necessary to handle the wings, which are conveniently transported into and out of the booths by being suspended from small trolleys on overhead tracks. A new technique in painting had to be developed to camouflage fighting aircraft. From the illustration it will be seen that the areas of different colored paints used in camouflaging are controlled by the use of large irregular shaped mats of rubber which are clamped to the plane surfaces. From the paint booths most of the parts go directly to the final assembly lines.

It is of interest to note that better tooling is possible because the large quantities permit a reasonable amortization of such improved tooling. This, again, results in more and better tools for those building the aircraft, and at the same time, a greater degree of interchangeability. This interchangeability, which is due in considerable measure to the improved tooling, also permits the use of unskilled or semi-skilled labor, including the employment of women.

Better tooling lessens the need for a large number of specialists or highly skilled workmen for operating equipment; thus, the available man power is used more efficiently. This is also re-

Fig. 20. Conveyor Unit Used for Drying Small and Medium-sized Pieces of Duralumin after They have been Dipped in Zinc Chromate to Provide Protection from Corrosion

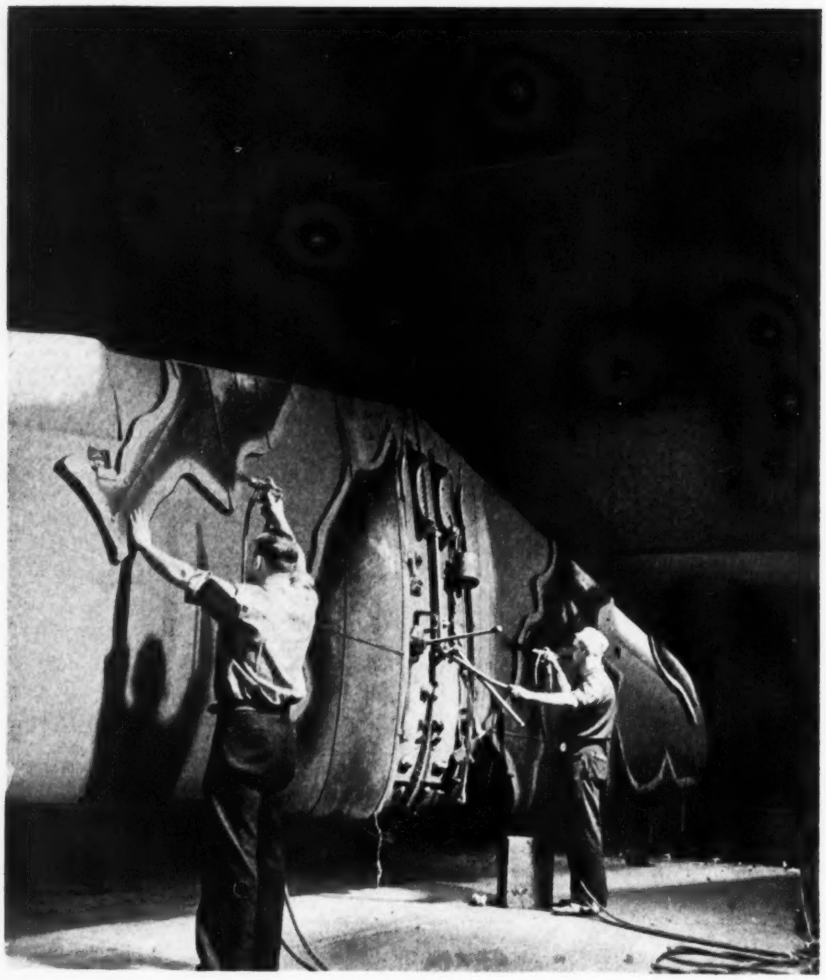


Fig. 21. One of the Large Paint Spraying Booths, Showing the Method by which Camouflage Effects are Obtained on the Wings of Fighting Planes

flected in the cycle of engineering, planning, tool designing, toolmaking, lofting, and development of techniques permitting a greater application of mass production methods, finally resulting in a product that is more completely interchangeable.

* * *

Machining with Coated Abrasives

The removal of substantial amounts of metal is being done in many instances with coated abrasives in the war industries, according to the Automotive Council for War Production. It has been found that such abrasives are more than merely polishing sandpaper. Precision results are claimed in many operations where the abrasives now replace former cutting operations.

An armor-plate producer, for example, uses a water-cooled belt grinder to remove 1/8 inch of steel from the edges of heat-treated armor plate to true up the edges. Forgings, castings, and die-castings are other parts that are being machined in this way. An aircraft engine manufacturer uses thin abrasive disks to perform an operation that forms a groove of about the same dimensions as a ring groove in an automotive piston. In this case, the tolerance is from 0.0008 to 0.001 inch, and the radii in the bottom of the groove are maintained.

These jobs are generally tooled up with accurate fixtures to hold the work. The trend is toward wet belt grinders, the liquid keeping down the dust and cooling the belt and work. There are possibilities of conserving machine tools and cutters by substituting such equipment for operations normally requiring milling machines, external broaching machines, drill presses, lathes, and similar machines.

* * *

Recommendations for Wire Rope

A proposed Simplified Practice Recommendation for wire rope, which promises large savings, has just been submitted to users, producers, distributors, and others interested, for approval and comment, by the National Bureau of Standards. The proposal was developed by the Contact Committee of the Wire Rope and Strand Manufacturers Association, and is submitted at the request of the Wire and Wire Products Section of the Iron and Steel Branch of the War Production Board.

The recommendations cover sizes, construction, grades and breaking strengths of the wire rope. General adherence to the recommendations will result in a reduction in varieties of wire rope from 973 items to 643, or practically 34 per cent. In the more generally used sizes and types of wire rope, the reduction in varieties is from 352 to 182 items, or 48 per cent. Copies of the recommendations can be obtained from the Division of Simplified Practice, National Bureau of Standards, Washington, D. C.

* * *

With farm machinery now difficult or impossible to obtain, thousands of young farm boys are taking special courses in high schools to learn how to take care of and repair the farm equipment already on hand.

Engineering News Flashes

Stratosphere Chamber for Testing Aircraft Parts

To test mechanical parts of aircraft and radio equipment used at high altitudes, the Kold-Hold Mfg. Co., Lansing, Mich., has developed and built a stratosphere chamber that operates at temperatures varying anywhere from 200 degrees F. above zero to 75 degrees F. below zero. It also operates at varying internal pressures. Both the pressure and temperature variations can be controlled throughout their range.

The stratosphere unit has an interior chamber volume of approximately 245 cubic feet. The refrigeration effect is obtained by forced convection through coils designed for low-temperature work. By the use of this equipment, data may be obtained within a few hours that it would take days to record with former methods of testing in special planes operated by highly trained test pilots.

Metals Salvaged from Ashes at General Electric Works

Ashes taken from two process - steam boiler pits are yielding valuable materials at one of the General Electric Co.'s major works. Shop refuse and rubbish from all parts of the works are used for fuel. Ashes removed from the boiler pits are passed through a ball mill or grinder; they then go to a magnetic separator, which separates the ferrous from the non-ferrous metals, and to a concentration table, which sorts out the finer particles. Metals reclaimed by this method include iron, steel, brass, copper, and aluminum. In 1941, a total of 624,000 pounds was recovered, representing a gross cash return of $10,000.

Wood Used in Place of Steel in Army Truck Bodies

The war has forced American industry in several instances to go back to wood. Through the adoption of wood as a substitute for steel in the cargo bodies of Army trucks, it is expected that more than 275,000 tons of steel will be saved annually. With the exception of those trucks that the Army designates as "special equipment carriers," all trucks of 1 1/2 tons capacity and larger are now built with wooden bodies.

In addition to the large tonnage of steel made available for other war production needs, the use of wood brings many small concerns, such as furniture makers, automobile body builders, and other woodworking firms, into the war production picture. Hence, much manufacturing capacity heretofore idle will be made available. At the same time, large metal - working plants in which the steel bodies were formerly made are now able to utilize their more versatile equipment on other weapons.

Substitutes Required for Substitute Metals

Nickel and chromium, as well as tin and zinc, are among the plating materials most used for protecting steel and other metals from rust, corrosion, and tarnish. As these materials went on the priority list, substitutes were discovered. Then substitutes for the substitutes had to be found.

For example, the cover of an electric roaster was originally made of aluminum. First, at one of the Westinghouse plants, plans were made to substitute stainless steel (containing chromium). But before these plans were put into effect, it appeared that stainless steel would soon become scarce, and new plans were laid for the use of chromium plating over nickel plating. Then nickel and chromium priorities ended that plan. Now, engineers are developing an enameled steel cover.

Many substitutes have been made for aluminum. Nearly every bit of this metal has been removed from electric refrigerators. Glass and enameled iron have been substituted for aluminum in dishes, trays, and other parts. Broiler pans and deep-well cookers on new ranges are made of enameled iron. Waffle - iron grids are made of cast iron. Plastics have taken the place of aluminum in washing machine agitators and vacuum cleaner nozzles.

Huge Synthetic Rubber Bags Turn Box Cars into Oil Tank Cars

The United States Rubber Co. manufactures an unusual type of synthetic rubber bag known as a Mareng cell, which enables ordinary freight cars to be used for hauling crude oil. The cells are manufactured under patents held by the Glenn L. Martin Co. The box cars are specially fitted to support these large cells or bags. It is expected that this development will help to solve the difficult problem of oil transportation during the coming winter.

EDITORIAL COMMENT

Scrap Will Help Produce Steel to Win the War

The Industrial Salvage Section, Conservation Division of the War Production Board, is now conducting a campaign to get just as much scrap as possible out of all industrial plants. The plan is to survey all plants to determine not only what scrap is immediately available, but also what may be available in the near future. An effort will be made to have the plants visited dispose of such scrap in ninety days. The Industrial Salvage Section is urging all industrial plants to communicate with the Section, mentioning how much scrap has been disposed of to junk dealers recently, and also how much prospective scrap may be available. Unless we collect more scrap, we cannot get more steel; and we must have more steel to win the war.

Simplified Design of War Equipment Speeds Production

An effort is being made by the Ordnance Department to speed the production of war material through the simplification of design, so that it can be more easily manufactured. Sometimes such simplified design may permit the use of less expensive manufacturing equipment or equipment that is available at the present time, without waiting for long deliveries.

Much has already been done in this direction. A booklet has been published by the Manufacturing Processes Section, Conservation Branch, Production Division, War Department, Washington, D. C., which cites a great many examples of cases where designs have been simplified so as to greatly increase production, reduce costs, and save scarce materials. Manufacturers who have war contracts and who feel that the parts they are manufacturing could be made more easily if there were a change in design or materials are urged to communicate with the Manufacturing Processes Section.

Sometimes it is apparent that redesign would be highly desirable from a manufacturing point of view, but for the sake of interchangeability it is not possible to make a change during the war. This, for example, applies to such equipment as rifles. It has been pointed out that parts for the rifles now being manufactured for the Army could be simplified in design so as to greatly facilitate rifle manufacture. Such change, however, would not be advisable now, on account of the importance of having all rifle parts interchangeable; and although some of these parts appear unduly complicated, requiring most difficult and cumbersome machining operations, there is no choice in the matter.

Newly developed equipment, however, should be designed with an eye to simplifying the manufacturing methods; and many already designed items — in cases where the question of interchangeability does not arise — offer a fruitful field for improvements that would speed up production and make the war equipment available sooner than would otherwise be possible.

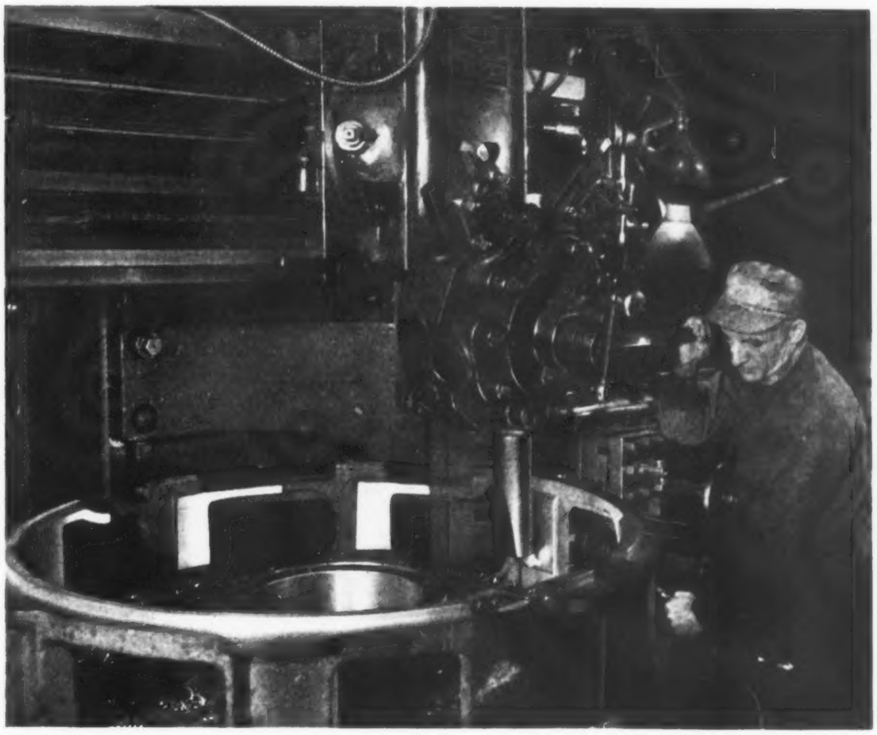
Employer No Longer is Permitted to Use His Own Judgment

According to a ruling made by the Industrial Commissioner of the state of New York under a law prohibiting employers engaged in the manufacture of war materials to consider race, creed, color, or national origin in hiring workers, the employer is not permitted to ask a prospective employe whatever questions he wishes, if these questions have any bearing upon the race, creed, color, or national origin of the applicant.

The idea behind the ruling obviously is that, if the employer knows the full facts relating to the prospective employe, he may not wish to employ him. In other words, the man who provides employment and takes the responsibility for raising the money with which to pay wages has no right under the law to determine for himself whom or whom not he wishes to employ. On the other hand, under Federal Law the employer is frequently required to discriminate and refuse employment to men who may not belong to a certain association or union. Such is the conception of fair play on the part of our law-makers.

Boring and Grinding Generator Brackets on a Vertical Turret Lathe

GENERATOR brackets for Diesel-electric shifting locomotives built at the Westinghouse Electric & Mfg. Co.'s plant in East Pittsburgh, Pa., are bored and then ground on the vertical turret lathe here illustrated. These brackets have a hub in the center which is rough-bored and faced with the machine set up as shown, after which the pads on the outer ribs of the casting are rough- and finish-bored, as shown in the illustration, for the attachment of brush-holder brackets. Two steps on top of the casting are also faced, and the shoulder between them is rough- and finish-turned to a diameter of 44.246 to 44.248 inches.



Boring and Grinding a Large Generator Bracket to Close Limits on a Bullard Vertical Turret Lathe

When these cuts have been taken, the casting is turned in the reverse position on the machine table and located on a fixture from the large-diameter bore. Then the smaller central bore is finish-bored and finally ground to between 12.5978 and 12.5988 inches to receive the outer race of a roller bearing. The grinding attachment is mounted on one of the turret stations for this operation.

Machine Tools from Automotive Shops Available to Other Industries

ACCORDING to information obtained from the Automotive Council for War Production, New Center Bldg., Detroit, Mich., nearly 9000 machine tools, presses, welding machines, and other types of manufacturing equipment that were moved out of automotive plants when they were converted to specialized types of war production have been shipped to other plants in the last six months to be used on war work.

For example, a shipbuilding company in Mississippi found uses for idle welding equipment. Several huge presses went to a plant in West Virginia. Even the upholstery machinery is being put to important useful purposes. A number of sewing machines formerly employed in the upholstery department of an automobile plant are now used by the Government for making tents and tarpaulins for the Army.

The store of machines thus available to industry has, in many instances, proved of great time-saving value. A factory in Massachusetts, for instance, devised a time-saving technique for the manufacture of bomb sights, but could not apply it because of lack of equipment. After futile attempts to obtain machinery for early delivery, the presses were found in a Detroit plant.

A similar experience was reported by a company which, after having developed a coining process for use in the manufacture of cartridge cases, was unable to apply this time-saving method until fifty idle coining presses became available from a former automobile plant.

War Industries Turn to Women

Slowly at First, but with Greater and Greater Speed as the Months Go by, Industry is Making Another Dramatic Change-Over. As Its Men Leave for Armed Service, Women are Stepping into the Production Lines

MORE production with less man power—that is the challenge facing industry today. Millions of American men are now in Army camps and combat areas. Millions more are expected to be called away from industry, while the demand for greater and greater production continues. From what source can these workers be replaced and others added? Of course, men not subject to the draft, because of age or physical handicaps, are available, but their number is limited. More and more industry must turn to the, as yet, almost untouched reservoir of woman power.

As far back as last summer, the management of North American Aviation, Inc., foresaw the possible exhaustion of the supply of men available to the aircraft industry. It also foresaw that, if the United States became a combatant in the war, a large percentage of the workers in war industries would have to be women, replacing the men called to service. Therefore, the company decided to begin employing women in factory work.

This venture was started as more or less of an experiment in the new Texas factory of the company. That particular plant was chosen because it was located in completely new territory, as far as the aircraft industry was concerned, and only a small percentage of the potential employes in that territory had had any previous aircraft experience. Women workers could, therefore, start on a par with men, from the standpoint of experience.

Twelve women were employed in the electrical sub-assembly department of the Texas factory on November 17, 1941, and these twelve soon established an enviable record for themselves. Hundreds of other women have followed them into this factory so that today women are employed in almost every department. Three and a half months after the first women were employed, nearly 10 per cent of the workers in this plant—exclusive of office employes—were women. On September 1, 1942, the percentage of women employes had risen to 21.

Two other North American plants in California and Kansas have followed suit, so that women are becoming responsible for an ever increasing share in the production achievements of these three plants. It is anticipated that, eventually, the number of women employed in these plants will be between 50 and 60 per cent of the total number of employes.

A considerable number of these women are doing factory work for the first time in their lives. Many of them are wives, mothers, and

These Women are Putting the Finishing Touches on Landing Light Doors while a Foreman Inspects Their Work. From Left to Right, the Women are Mrs. Eva Mae Williams, Housewife; Mrs. Sarah Jaycox, Former Professional Dancer and Dancing Teacher, whose Husband is Now in the R.A.F.; and Mrs. Pearl Gaston, Former Clerk in a Mail Order House

as Men Become Scarce

Approved for Publication by the War Department

sisters of men in the service, who are doing their utmost to help safeguard the homes and way of life for which their men are fighting. Indicative of the various walks of life from which these women are drawn are the following examples:

Miss Evaline Clarke Sellors is employed in the foundry, where she is engaged in making molds for Kirksite dies. She also teaches sculpture in a technical evening school. Her educational background includes study at the Pennsylvania Academy of Fine Arts in Philadelphia and two years work in European art schools. She still does art commissions, in addition to her work in the factory and her teaching job.

It is a long jump from a piano to a milling machine, but Miss Edna May Montgomery had little difficulty in making it. Here, again, is an example of the unusual background of women who have taken their places in the battle line of production. Miss Montgomery formerly taught piano in the Arkansas public schools. She was the first woman to be given the job of operating a milling machine in the North American plant.

Within a week after she had started on the machine, she was able to go ahead on production without direct supervision, even making her own set-ups. Her first airplane factory job was on a squeeze riveting machine. It was because she showed so much natural mechanical aptitude on this job that she was transferred shortly to the more complicated milling machine. Now she is looking forward to being advanced to one of the machines that require the highest type of skill.

Mrs. Sarah Jaycox was formerly a professional dancer and dancing teacher. She and her husband taught dancing at the Arthur Murray Studios for several years. Several months ago, Mr. Jaycox began taking a Civilian Pilot Training Course. Having finished it, he enlisted in the Royal Air Force, and went into training with an Eagle Squadron unit at Tulsa, Okla.

"He was going to do his part to help win this war, and I didn't want to be left holding my hand as far as the war was concerned," Mrs. Jaycox exclaimed. So she went to Texas, and is now working on plastic enclosures for pilot cockpits and gunner turrets.

Mrs. Eva Mae Williams is typical of the many housewives who are entering the war industries. Her job in the aircraft plant was the first she had ever had outside of her home.

"What with the war going on and so many others making important sacrifices, I began to feel more and more depressed at not doing more. I found that my friends were also living under that terrible feeling of tension. As soon as I went to work here, however, I lost that feeling of depression and tension. Now I feel that I am doing all that I possibly can, and I am satisfied." Mrs. Williams is employed in the fabrication of plastic enclosures.

North American was not the first aircraft manufacturer to employ women, but it has be-

Running a Milling Machine was Once Thought to be Exclusively a Man's Work. But Times have Changed, and Here is Miss Edna May Montgomery in a Texas Factory of North American Aviation, Doing Just that. The Operation on which She is Engaged is Cutting Tubing for the Fuselage Frame. Miss Montgomery was Formerly a Piano Teacher

(Above) Mrs. Luella Monroe, Former Salesgirl in a Department Store, is Securing Engine Assemblies in Place, so that They can be Moved Easily. Mrs. Monroe Looks Forward to Becoming a Full-fledged Airplane Mechanic

come one of the industry's outstanding employers of women. Its percentage of women employes in the Texas factory is believed to be as great as that of any other unit of the industry, if not greater; and the California and Kansas plants are rapidly approaching the Texas level. It is also believed that women employes of North American hold a greater variety of job classifications. Foremen of the three plants are unanimous in agreeing that women make excellent aircraft workers. Their dexterity, power of concentration, and interest in the work enable many of them to rival the production records of men only a few weeks after they have entered the factories.

No Special Training Requirements for Women

No special training is required of the women applicants. However, pre-employment training is highly desirable, and can be obtained by the women without cost to them in national war training schools. These schools are operated in the industrial centers and in the vicinity of war industries by the local public school systems through the financial support of the state departments of vocational education and the Federal Security Agency.

After employment, a woman is required to take a six-hour course of "in plant" training covering such subjects as company history, policy, safety, work simplification, and rules and regulations. Furthermore, each woman is actually in training constantly under the supervision of "lead" men and foremen, who direct her work and help her develop skill and efficiency. The company's education department coordinates the supplementary training facilities provided by the schools and colleges in the areas in which the plants are located, and many women are taking these training courses to prepare themselves for more highly skilled work.

Established Employment Procedure Followed

When the applicant has answered the questions on the company's application form, she is interviewed by the personnel department. General intelligence, aptitude, and a genuine desire

Long Hours of Patient and Careful Work Go into the Forming of Plaster Patterns for Aircraft Parts. Working on These Patterns are (Front to Back) Miss Julia Porter, Miss Evaline Clarke Sellors, Miss Irene Albright, Miss Jeanelle Epperson, and Mrs. Cora Hall. All These Women have had Training in Sculpture and Pottery Work

to work are the essential considerations. All other factors being equal, the company gives preference in the employment of women to the wives, mothers, and dependents of men in the military and naval services.

Sixty-one per cent of the women are married, and a large percentage of these—an estimated 65 per cent—are the wives or mothers of men in the service. Sixty-eight per cent are high school graduates, and 13 per cent have had college training. Only 34.9 per cent have had previous factory experience. For the most part, their previous industrial experience was in "light industry"—apparel factories, venetian blind factories, candy factories, etc.

In order to secure applicants in an orderly manner, the company keeps the United States Employment Service informed of its labor needs, and requires that an applicant come to the personnel department with a reference card from the Employment Service.

Working Conditions are Good and Pay is on Par with that of Men

Women receive the same wages as men for the same type of work. They are paid on an hourly basis — never on piece-work. Women work a basic eight-hour day, five-day week. They receive time-and-a-half for over-time. The amount of over-time a woman may receive is governed by the respective state laws regulating conditions of work for women.

The only special regulation for women is that they are required to wear uniforms, primarily for safety reasons. The company has approved an attractive, durable slack suit of blue drill, which can be purchased for $4.80. Likewise for reasons of safety, women are not permitted to wear open-toed shoes, and when working around certain types of machinery, must have a covering on their hair. The reaction of women workers to uniforms is favorable—they are economical, mean big savings in hosiery, and help emphasize the fact that the women in the factory are working there on the same basis as the men. The "feminine touch," however, is to be found in colored neckerchiefs, hair ribbons, and occasionally in bright sweaters which the women wear beneath the jackets of their slack suits.

The women don't get—and don't expect—any

(Above) Mrs. Venita Anderson (Left) and Mrs. Georgia Krodell (Right) are Working Together as Riveters on Side Panels. Both Women have Seven-year-old Sons and Mrs. Anderson also has a Four-year-old Daughter

Molding Plexiglas into the Proper Form for Use in Cockpit Enclosures is a Job at which Women have Proved Particularly Successful. Mrs. Crystal Macon, Wife of a Soldier, is Laying the Heated, Pliant Plastic over a Mold. Mrs. Macon Worked Five Years in a Millinery Shop and the Skill She Acquired there has Helped Her Greatly in This Job

WOMEN IN WAR WORK

One of the First Machines to which Women were Assigned was the Drill Press. Operating This Series of Three Presses are Miss Ruth Jackson, Former Drug Store Cashier; Mrs. Ethel Holtz, Beauty Shop Operator; and Mrs. Lonnie Newman, Previously a Buttonhole Machine Operator in a Garment Factory. Women have Proved Especially Accurate on This Type of Work

special privileges in the factories. They accept their jobs on an equal basis with men. Experience has shown that the men simply regard them as fellow-workers; they like to talk with them in the lunch periods, but the women have not been a "disturbing influence" in the factories by any stretch of the imagination. It is very unusual to see a man look up if a woman worker walks down the aisle. On benches where men and women are working side by side, the relationship is no different from what it would be if all the employes were men, or all women.

Women have virtually the same opportunities as men. They have the same opportunity for salary advancement, and the time probably will arrive shortly when women who have distinguished themselves in their work will be promoted to supervisory positions.

The aircraft factories are clean and wholesome. The Texas and Kansas plants are "blackout" factories—air-conditioned, with fluorescent lighting, for constant temperature and constant light conditions. The work, women employes have found, is neither dirty nor heavy; it requires skill, precision, and intelligence.

Women are being Placed in a Large Variety of Jobs

Women employed in the North American factories are now engaged in soldering; flanging; forming metal parts; wiring electric boxes; radio and instrument assembly; Magnaflux machine and magnetic inspection; wire manufacturing; controls assembly; making plaster forms for metal dies and plastic enclosures; build-

Mrs. Modell Taylor has been Assigned to "Buck" Rivets as They are Driven into the Cowl Assembly Engine Rings by John N. Nolen. Mrs. Taylor is a Former Beauty Parlor Operator. Many Men and Women have been Successfully "Teamed up" for Similar Operations

ing landing lights; tube bending; assembling hydraulic equipment; fabric covering of control surfaces; inspection; riveting; welding; acting as tool-crib and stock-room clerks; painting; and all types of sheet-metal work. They are operating engraving machines, electric hand drills, drill presses, turret lathes, milling machines, and numbering and stamping machines. As time goes on, they will be employed in an even greater variety of work.

From the experience already gathered regarding the employment of women in war industries, the following conclusions can be drawn:

1. Overnight, industry has learned that women can be as capable, efficient, and interested in these occupations as men. This is particularly true in the aircraft industry, which has found that women learn quickly, and in many jobs are more inherently adept and skilled than men.

2. Wives and mothers are finding economic security for their homes and families, preserving within the nation what we are fighting for; if they were not gainfully employed, the military service of husbands and fathers and the resultant loss in family income would threaten the security of the home.

3. Women's service on the production lines is a tangible contribution to the country's morale: A woman who is doing her full share to produce the instruments of war has a better understanding of the true meaning of the national effort, has a more personal "stake" in the outcome, and has the satisfaction of knowing that she is contributing directly and importantly to victory.

4. The public concept of factory work is changing. Women are learning that factories can be clean, pleasant places to work in; that the work does not tax their strength; that there is a satisfaction in doing work with one's hands which cannot be found in any other type of labor; that work in a factory does not mean a loss of social prestige but rather—in wartime at least—a distinction to be sought.

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Centrifugal Casting of Unsymmetrical Parts

According to information obtained from the Automotive Council for War Production, unsymmetrical parts are being centrifugally cast in production by the expedient of counterbalancing the molds. This simple improvement enlarges the scope of the centrifugal casting technique. An airplane landing-gear pivot is one part being produced this way. Previously, it was made from steel plate by welding together eighteen separate pieces, the job requiring 15 feet of welding. The cast-steel part is 3 pounds lighter than the built-up part.

Norton Co. Offers Motion Picture Lessons in Grinding

The Norton Co., Worcester, Mass., has produced a new series of motion pictures entitled "Lessons in Grinding" to meet the demand for practical information on grinding methods, especially in connection with apprentice training courses in war-work plants. The series includes four films, No. 1 dealing with cutter sharpening; No. 2 with the cylindrical grinder; No. 3 with the surface grinder; and No. 4 with the grinding wheel—its care and use.

These films are available to industrial apprentice schools, Army and Navy training schools, colleges, universities, and vocational schools, and all classes where machine shop practice is being taught. They are intended to present the fundamentals of grinding in such a way that the inexperienced man can easily understand them. The films can be obtained by writing directly to the Norton Co., Publicity Department, Worcester, Mass. They are supplied for one-time showings without charge, except for return transportation. When desired, however, the films can be purchased for permanent use at cost.

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Excessive Inventories of Materials

All manufacturers are required to report to the Materials Redistribution Branch, War Production Board, Washington, D. C., idle or excessive inventories of all kinds of materials, especially of metals. The Government will buy such excessive inventories from those who have them on hand at prices that have been fixed for each class of material. Questionnaires have been sent to industrial concerns for listing materials that may be on hand. Manufacturers are asked to cooperate with the Government in this matter, since it is obvious that it would greatly aid the war effort if all kinds of materials not otherwise used were immediately made available for the production of war equipment. For further information, communicate with the Materials Redistribution Branch of the W.P.B.

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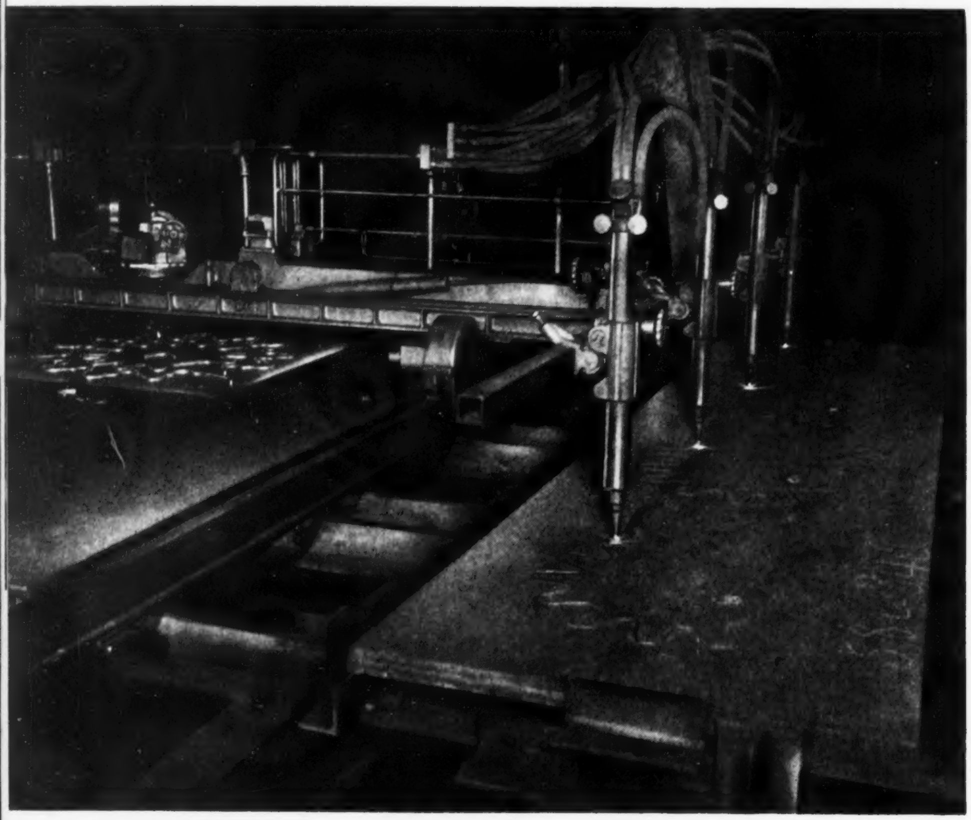
Palladium as a Substitute for Platinum in Jewelry

Because of the restrictions placed on the use of platinum in jewelry by the War Production Board, palladium is now being used instead of platinum. There are ample supplies of this metal. According to Charles Engelhard, of Baker & Co., Inc., Newark, N. J., palladium is available in sufficient quantities to furnish the jewelry industries with a satisfactory substitute for platinum.

Flame Cutting and Hardening Aid

Approved for Publication by the War Department



(Above) Four Tank Sprockets are being Cut out Simultaneously by This Oxy-acetylene Cutting Machine. A Templet-riding Device Shown at the Left, Automatically Guides the Blowpipes in Cutting the Exact Contours

THE manufacture of tank sprockets is being speeded by two oxy-acetylene flame processes—shape-cutting and hardening—which are being used widely throughout the war industries. These two processes make possible the rapid fabrication of the sprockets to the proper shape and the hardening of their load-carrying surfaces to the exact degree required.

The cutting operation is accomplished on a multiple basis through the use of a master templet - riding device which guides the cutting blowpipes in following the proper outline. Sharp, clean contours and rapid production are thus made possible. Straight lines, circles, or irregular shapes can all be obtained by this method.

The use of a multiple-flame blowpipe for heating the tooth surfaces above the critical range, followed by a water quench, imparts a suitable hardness to these load-carrying areas. This specially designed flame-hardening equipment permits close control of the hard-

Close-up View of the Cutting Operation on the Tank Sprocket, Showing the Outer Surface of the Sprocket being Cut by a Blowpipe after Completion of the Inner Contour

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Tank Sprocket Production ★

Photographs, Courtesy The Linde Air Products Company

ness depth, leaving the underlying metal relatively tough and ductile. The process is also being used to harden other tank parts such as turret-ring raceways and grousers. Further examples of the application of this process include the hardening of armor plate and of automatic rifle parts.

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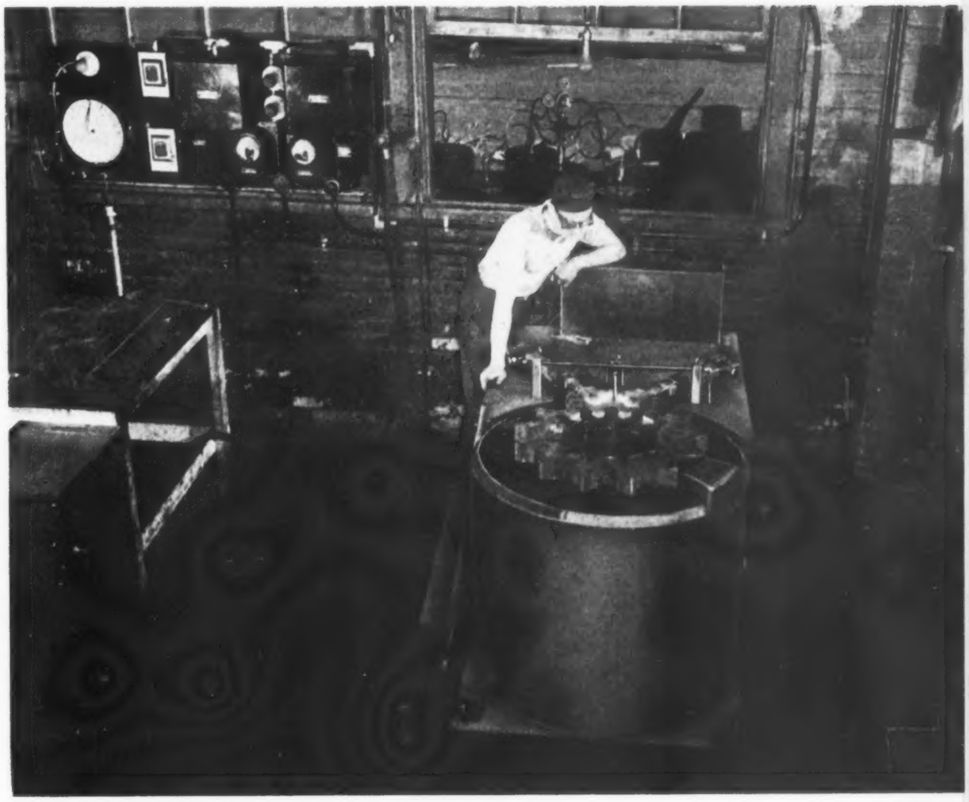
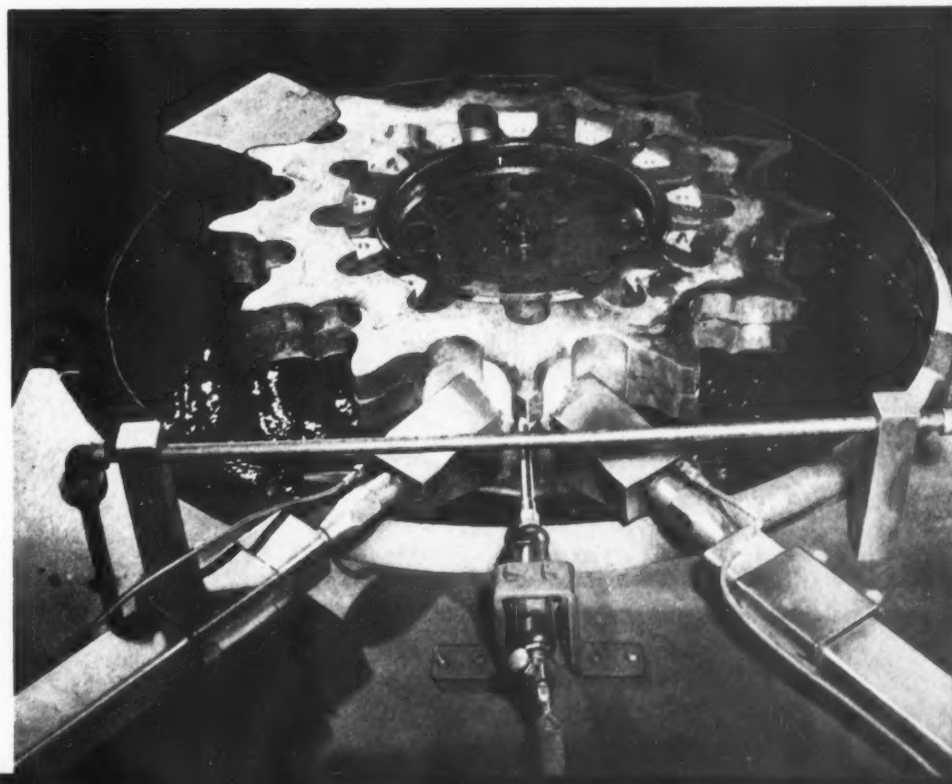
American Zinc Institute Discusses Zinc Substitutes

The Galvanizers Committee of the American Zinc Institute, Inc., 60 E. 42nd St., New York City, held a meeting at the William Penn Hotel, in Pittsburgh, Pa., on November 20, at which wartime and peacetime practices were discussed, and particular attention was given to substitutes for zinc coatings. The entire program was designed to provide the members of the Institute with information on current problems and future trends in the uses of zinc, zinc substitutes, and zinc conservation.



(Above) After Flame-cutting, the Sprockets are Broached and Drilled, then Placed Two at a Time in Position for Flame-hardening of the Teeth. The Sequence of Hardening Operations is Regulated Electrically



Hardening with Twenty-one-flame Heads. Two Teeth at a Time (One on Each Sprocket) are Heated, after which They are Automatically Lowered into the Water Bath and Quenched

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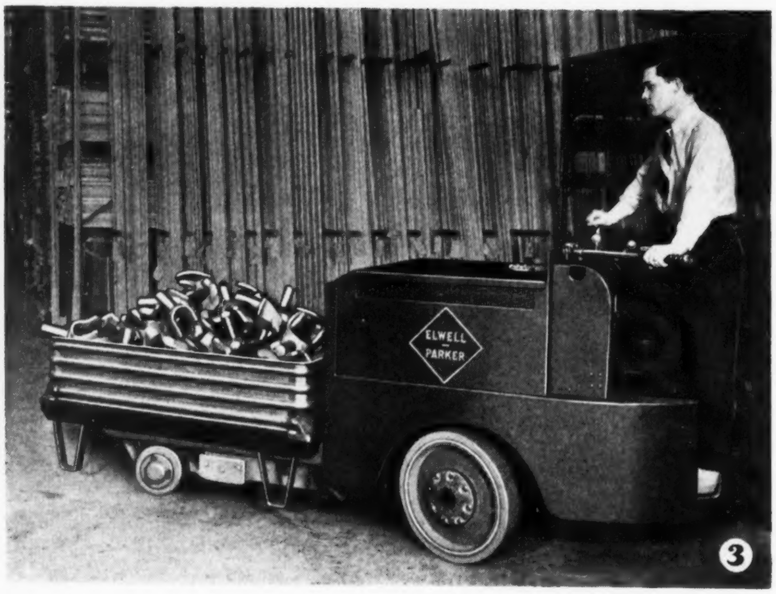

Power Trucks in

Approved for Publication

THE transportation of the enormous amount of materials and parts passing through a modern aircraft plant is handled in a large new manufacturing establishment in Ohio chiefly by industrial power trucks with specially designed auxiliary equipment. The high rate of production and the necessity for avoiding delays in production demand that materials, supplies, and parts be stored in such a manner that they are easily accessible and can be delivered quickly to the point where they are required. Industrial power trucks meet these requirements in a satisfactory manner, and the transportation system within the plant has been designed around them. They are used both as independent trucks and as tractors, according to the service to be performed.

Freight cars with raw material and parts supplied by other concerns enter the plant on the company's own spur track inside the building. As a result, there are no outdoor trucking operations of any kind. The outside concerns that supply parts are requested to make deliveries in types of containers convenient for handling by industrial power trucks, whether boxes, barrels, bags, or bales. The barrels in Fig. 1, containing aluminum castings and forgings, come directly from the freight cars, and are stored on skids of the type shown until required in the various machining departments.

For convenient handling of miscellaneous parts to be delivered to the many departments within the plant, some simple but unusual types of skids and trailers have been developed, each suited to the materials to be handled and the service to be rendered. Fig. 2 shows a double-deck skid which makes it possible to handle odd pick-ups or deliv-

an Aircraft Plant

by the Navy Department

eries conveniently without having to pile the boxes on top of each other to such an extent that they are not easily accessible. This not only saves time and effort, but also prevents mistakes, since the various cartons, boxes, etc., are in plain view.

Parts to be moved from the storage to the machining or assembly departments, or parts moving from one machining operation to another, are transported in skid boxes specially built for strength and rough usage, as shown in Fig. 3. These containers are designed somewhat on the principle of sectional bookcases, so that they may be used either singly or stacked in double heights. The capacity of the skid container may thus be doubled by simply placing one container frame on top of another, as shown in Fig. 4.

Special trailers or carriers of greater capacity than those shown in Figs. 3 and 4, for use when large pieces or a heavier load is to be transported, have been designed by the company for carrying parts around the plant. These trailers can be uncoupled and left wherever required while the power truck proceeds to perform other haulage service elsewhere. Thus time is saved, as the power truck need not wait for loading or unloading. A large supply of these trailers is provided, so that the power trucks can be kept busy at all times, without being tied up any longer than required for the actual hauling.

Fig. 5 shows one of these trailers used for hauling miscellaneous parts, while Fig. 6 shows a double-deck trailer of different construction, built to handle large parts that must be carefully transported, but that can be moved in considerable quantity by a single truck acting as a tractor.

In order to operate a fleet of power shop trucks economically,

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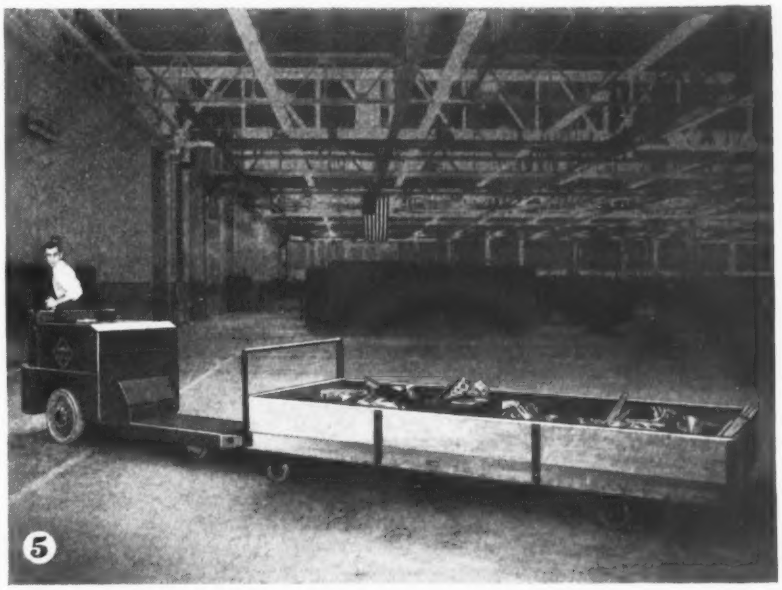

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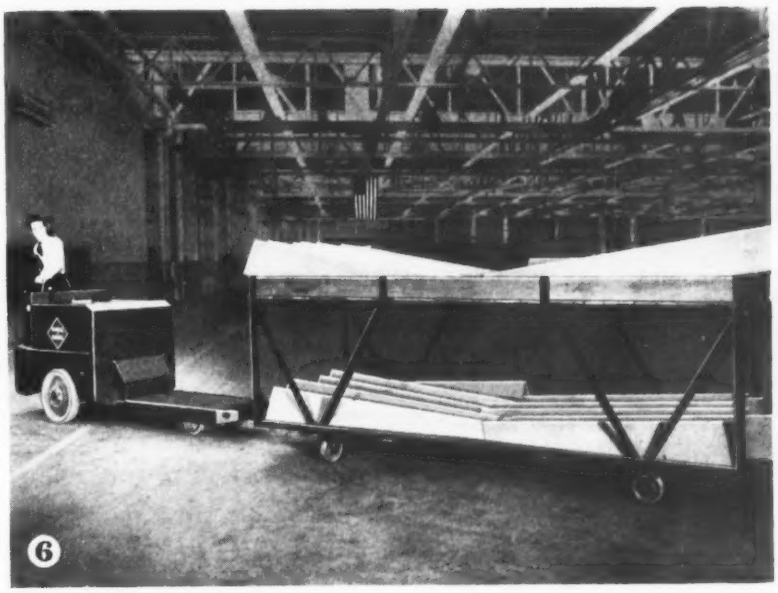

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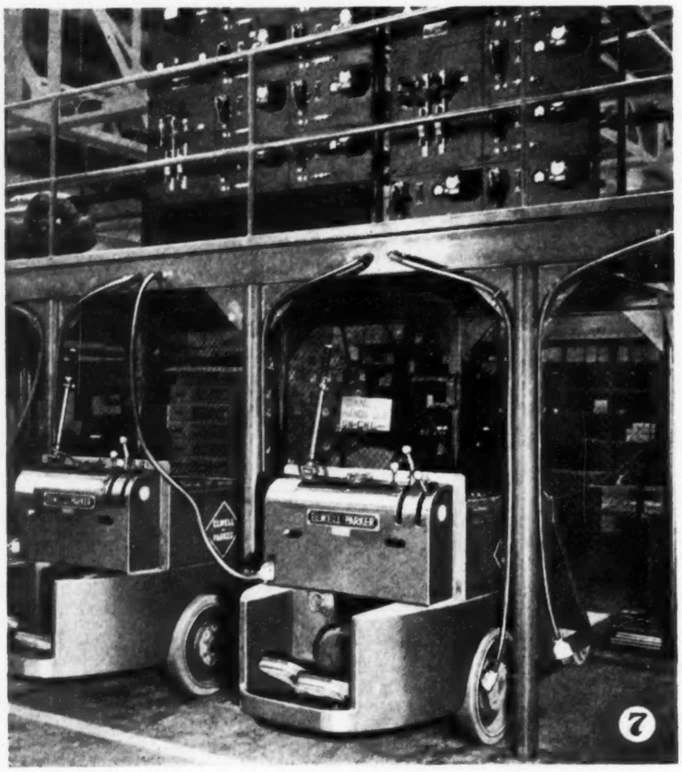

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precautions should be taken to prevent loss of time when batteries require recharging. In this plant, arrangements are made for what might be called "continuous charging" of batteries. With this system, the truck is sent to the charging station as soon as the battery begins to show evidence of running down, and a freshly charged truck is placed in operation meanwhile. Thus, as shown in Fig. 7, the batteries can be recharged without removal from the truck, which greatly simplifies the operation.

While the methods described appear simple, they were adopted only after careful planning and analysis. The object sought was to provide the simplest possible means of moving parts in the plant with dispatch and efficiency. The industrial power truck applied as indicated serves this purpose with satisfactory results.

The illustrations in this article are published through the courtesy of the Elwell-Parker Electric Co.

Getting in the Scrap at the Westinghouse Plants

ONE of the most important problems facing the American war effort is that of scrap metals. We need every pound of scrap that can be obtained from industrial plants, from homes and farms, and from the automobile graveyards. Many industrial concerns have organized scrap drives with remarkable results. One of the successful drives was instituted by the Westinghouse Electric & Mfg. Co. The various divisions of that company collected five million pounds of metal, rubber, and other materials needed for the war within three months. This was in addition to the routine collections of scrap regularly made in all the Westinghouse divisions.

In this scrap drive, everything of doubtful future usefulness was scrapped. Many old electric motors were included. One division turned in 300,000 pounds of old metal parts. An abandoned transformer tank in the high-voltage laboratory was dismantled to produce ten tons of steel and five tons of copper. Five miles of old telephone line were ripped up to produce eight tons of lead and another ton of copper. In one division alone, enough metal was turned in to build thirty-five 3000-kilowatt generators like those now manufactured for the nation's war industries.

This does not mean that the material would otherwise have been wasted, but it would probably have been lying idle for a long period. In the scrap drive, the tool drawers in the workbenches, office desks, and storage bins were ransacked for metal parts and old tools that were nc longer being used.

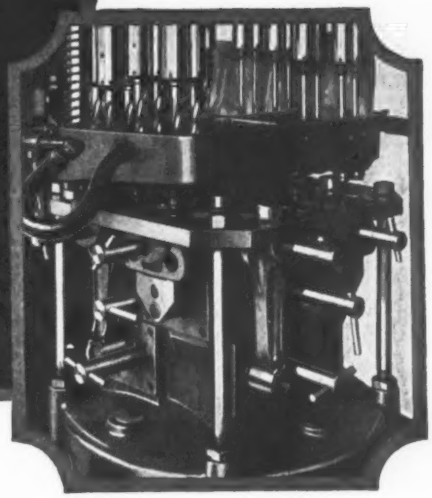
* * *

Motion Picture on the Economical Use of Cutting Tools

A one-reel sound picture has recently been completed by the International Harvester Co., 180 N. Michigan Ave., Chicago, Ill., the purpose of which is to demonstrate how to use cutting tools to their full capacity. The motion picture shows how the Harvester company's tool salvage program was organized and how it functions, from the salvage in individual plants to the working of a central clearing house for the utilization of excess and obsolete tools.

The picture emphasizes such matters as the low-temperature brazing process for repairing broken or damaged tools, regrinding to smaller sizes, or reworking to a different type of tool. It shows how slitting saws, reamers, drills, broaches, hobs, and milling cutters are repaired, ground smaller, or made over. The film is available for showing to workmen in industrial plants without any other charge than that of transportation. It is available in 35- and 16-millimeter sizes.

Design of Tools and Fixtures



Milling Machine Vise with Swivel Jaw

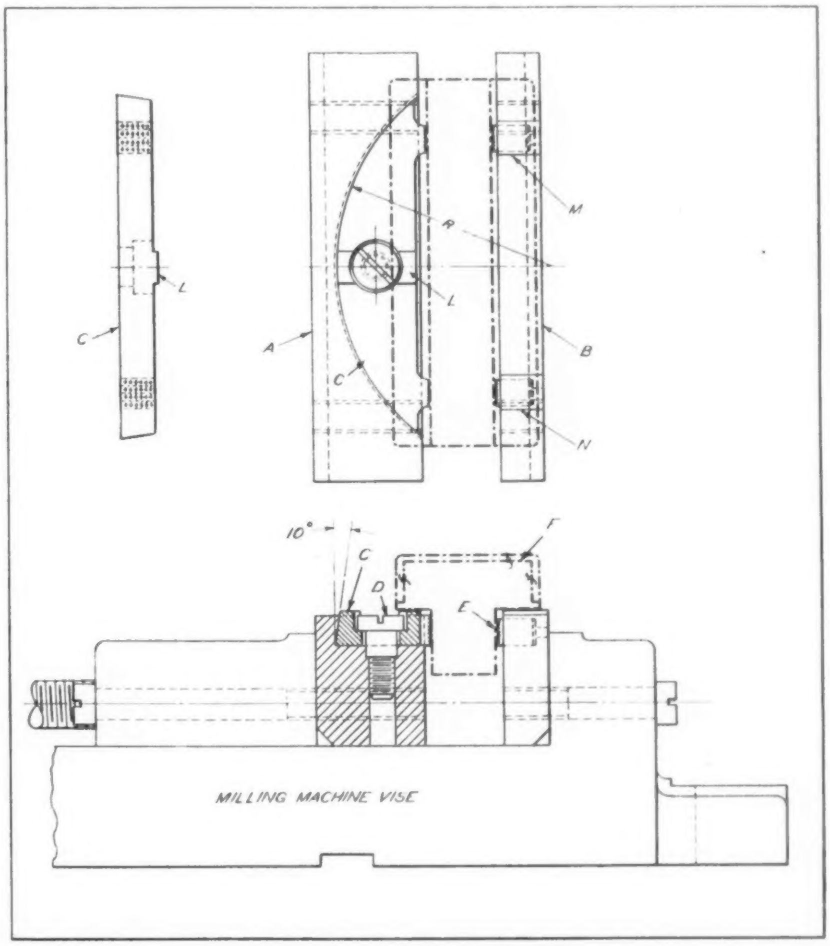
By P. E. VERAA, River Edge, N. J.

The practical value of the milling machine vise is often overlooked in planning machining operations, particularly those that are to be performed in the production line. A milling machine vise of the plain or swivel jaw type will frequently save the cost of a fixture. It is especially adapted for use in performing the first milling operation on castings of certain shapes for which quick set-ups and efficient clamping are necessary.

Difficulty, however, is sometimes experienced in clamping rough castings in a milling machine vise when the faces to be gripped by the vise jaws are uneven and out of parallel. Under such conditions, the contact area of the jaws should be reduced, and provision should be made for a certain amount of floating action for one of the jaws. The milling machine vise shown in the accompanying illustration was especially designed to meet these requirements.

The movable vise jaw *A* consists of a floating clamping segment *C*, designed to efficiently clamp the casting *F* against pins *E* pressed into the stationary jaw *B*. If the casting faces are not parallel, the clamping segment will move, causing equal pressure at the clamping points, and thus eliminating uneven strain on the vise jaws. The shoulder screw *D* which holds segment *C* in place has sufficient clearance in the counterbored hole to permit a sliding motion.

The work, to be milled as indicated by the



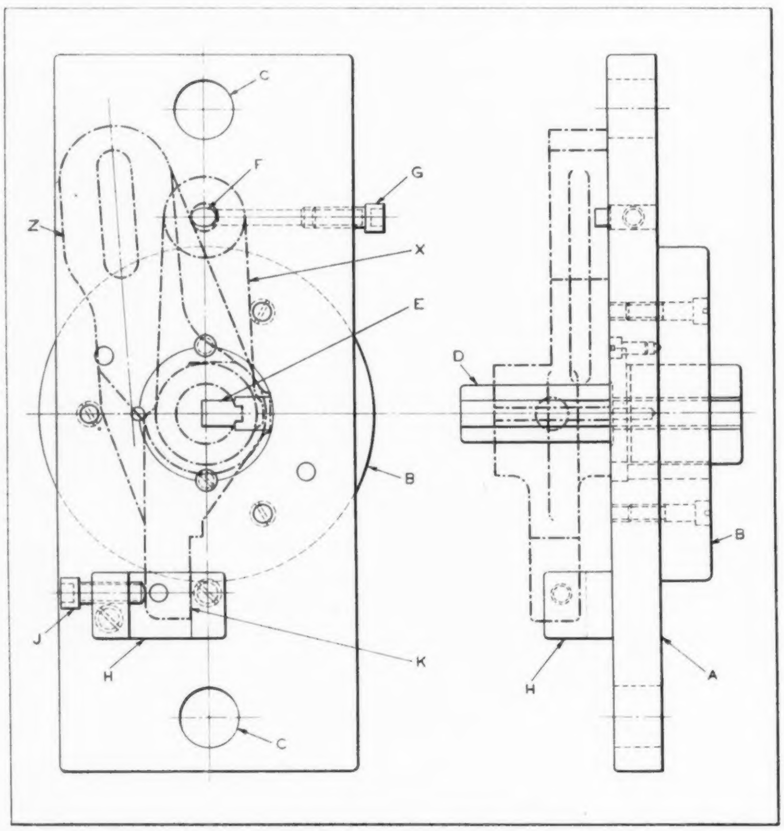
Milling Vise with Swiveling Jaw C for Clamping Work Such as Shown by Dot-and-dash Lines at F

finish marks, rests on the raised pads *L*, *M*, and *N*. The movable segment *C* has its serrated clamping pads located opposite the faces of the hardened steel pins *E*. All clamp faces have diamond pattern teeth or serrations to provide a better grip on the work. The back face of the clamp segment is machined to an angle of from 10 to 15 degrees on radius *R*. This angular contact causes a downward clamping action and keeps the casting firmly located on the supporting pads. The angular cut of segment *C* can be omitted if sufficient material is allowed for finishing the lower face of the casting.

Broaching Fixture Designed to Produce Keyways in Two Different Parts

A broaching fixture for cutting the keyways in the shaft holes of two entirely different parts is shown in the accompanying illustration. One part is a plain short-center lever, as indicated at *X*, while the other part is an adjustable operating block having an outline such as shown at *Z*.

The body of this broaching fixture consists of plate *A* with a circular portion at *B* which fits the end of the broaching machine. Two bolt holes *C* are provided for fastening the fixture in place. The pieces broached on this fixture are located by being placed over arbor *D*.



Fixture Designed for Broaching Keyways in Two Different Parts

The keyway broach passes through slot *E* in both cases. In broaching lever *X*, the outer hole is located over pin *F*. Screw *G* is loosened and pin *F* removed to adapt the fixture for broaching block *Z*. Locating block *H* is held in place by screws and dowels. The edge of work *Z* is located against block *K*, being held in position by screw *J*. The broaching of these two parts is accomplished by pulling the broach through the hole in the usual manner. F. H. M.

Ball-Bearing Indexing Fixture for Slotting Heavy Work

Hand-indexing of a fixture employed for slotting heavy work often subjects the operator to excessive fatigue. Moving the combined weight of a heavy piece of work and the indexing member of the fixture may require considerable effort, and the difficulty experienced in accurately aligning the heavy members to permit inserting the indexing pin may also result in loss of time and patience. The fatigue-producing effect of these factors, which increases as the mass of work increases, has been lessened to a considerable degree in the case of the fixture shown in the accompanying illustration by the use of a ball thrust bearing.

This fixture was developed by a British designer for use in cutting thirty-six parallel serrations along the bore of the work indicated by dot-and-dash lines. The work in this case weighed approximately 650 pounds. Obviously, indexing this weight thirty-six times, when mounted on a fixture of conventional type with plain bearings, would prove a very slow process and would place excessive strain on the operator.

The lower race of the 10-inch bore, extra light Hoffmann ball thrust bearing *B*, used in the fixture, is a close fit in the accurately machined groove of the heavy cast-iron base *A*. The locating or indexing plunger slot *C* in the cast pillar has hardened jaws *D* finish-ground in position to align the center of the slot with the center line of the fixture. Cover plate *E*, placed over slot *C*, prevents damage to the jaws when the fixture is not in use.

The heavy cast-iron table *F* has a machined trunnion which fits into base *A*, and an annular grooved face which rests on the upper race of thrust bearing *B*, clearance being provided between

the upper face of the base and the under side of the rotating table to eliminate friction. The table is locked by means of the large nut G, screwed on the stem of the rotating table. Access to this nut is obtained through a slot running from the pocket to the outer periphery of the base. Nut G is locked or loosened by a pin inserted in one of the numerous holes provided in its rim.

A hardened and ground washer H is inserted between the nut and the locking face of the base to insure an even locking action on the ball thrust bearing and to avoid damage to the locking face of the base. This insures keeping the face true and at right angles to the direction of the locking action.

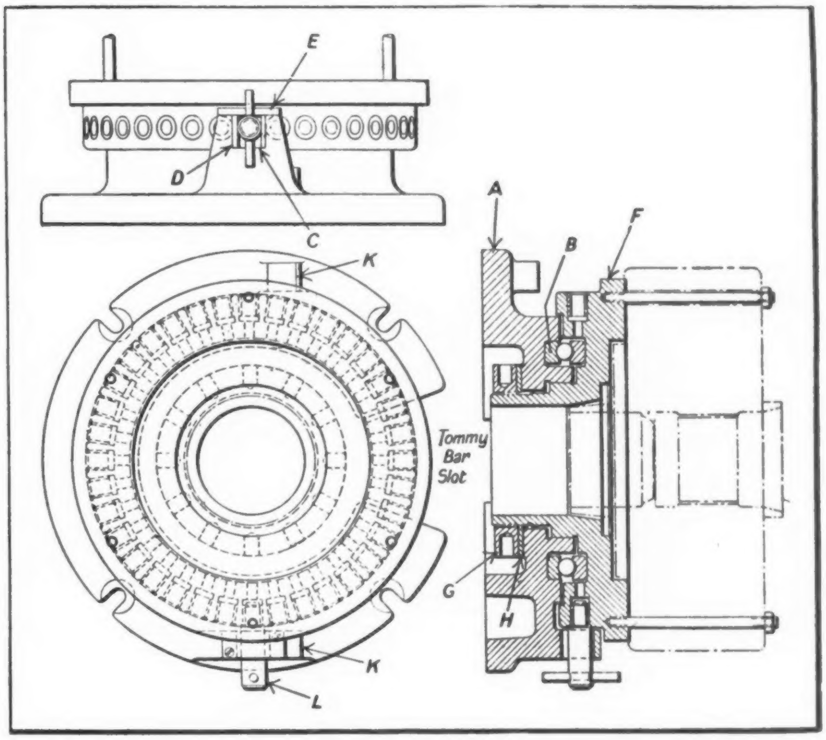
Indexing is obtained by means of a plunger L located in the hardened steel jaws of the base slot and the hardened steel bushing pressed into the periphery of the rotating table. The locating slot is used in the base in place of the usual hardened steel bushing to allow for downward movement of the rotating table when it is being locked. The fixture is provided with three bushings having different bore diameters to accommodate different pieces of work, these bushings being a press fit in the races provided for them. The work is clamped to the rotating table by means of four studs running through holes especially provided for lifting purposes.

Two vertical setting faces K, machined parallel to the center of the fixture, facilitate accurate location on the machine table. This fixture can be adapted for varying numbers of serrations by providing separate rotating tables having the requisite number of indexing bushings. It is also possible to adapt a fixture of this kind for taper splining by machining the ball-bearing seat and bore of the base at an angle equal to one-half the included angle of the taper spline to be cut. This sets the work over at the correct angle for cutting the spline with the downward vertical movement of the slotter ram.

Two of these fixtures, one for taper work and one for parallel slotting, have given very satisfactory service for several months. W. H. R.

* * *

Fifty per cent of the employes in the munitions plants in England are women. In the British machine tool industry, 35 per cent of the workers are women.



Heavy-duty Indexing Fixture for Slotting Operation

Sound and Color Motion Picture of Turret Lathe Operation

The Gisholt Machine Co., Madison, Wis., has recently announced the completion of a new sound and color motion picture entitled "Turret Lathes—Their Operation and Use." The production of this picture was undertaken to aid in solving the problem caused by the shortage of trained industrial workers. This sound motion picture will be released as a training medium to supplement actual basic shop practice, and was made entirely in a specially constructed studio at the Gisholt plant. The film is of 16-millimeter size, and will be available to all recognized trade schools, technical schools, and manufacturers without charge. It constitutes another valuable addition to the educational films in the machine shop field recently produced.

* * *

Prizes for Information on Metal-Spraying Procedure

The Metallizing Engineering Co., Inc., Long Island City, N. Y., has offered prizes totaling $650 in war bonds for information on maintenance and salvage procedure with the metal-spraying process. The first prize is $250; the second, $150; the third, $100; and there are three additional prizes of $50 each. The contest closes December 15. Further information can be obtained from *Metco News*, 21-07 Forty-first Ave., Long Island City, N. Y.

Questions and Answers

A Department in which the Readers of MACHINERY are Given an Opportunity to Exchange Information on Questions Pertaining to the Machine Industries

Dies for Making Eyes in Needles

R. G. W.—I would be interested in a description of approved designs for dies employed in making eyes in needles. These needles are of a heavy type, such as is employed for sewing sails, mattresses, gloves, etc. They are made from wire 1/32 to 5/32 inch in diameter.

Due Diligence before the Patent Office

O. A.—Can a five weeks' delay in the signing of a patent application be fatal to the applicant on the question of priority in an interference procedure?

Answered by Adelbert Schapp, Patent Attorney
San Francisco, Calif.

The executive who is used to the leisurely procedure before the United States Patent Office is likely to be surprised at a recent decision of the U. S. Court of Customs and Patent Appeals regarding the question of diligence in filing a patent application.

When two applicants contend over the same invention before the Patent Office, an interference is declared. The principal issue of the interference is priority of invention. Priority depends upon date of conception and date of reduction to practice. The first to conceive the idea is entitled to the patent, provided he has used due diligence in reducing the invention to practice.

Brown and Johnson (assumed names) had filed patent applications on an automobile body. Under the technical rules of the Patent Office, Brown was entitled to December 8, 1932, as the effective date of conception and reduction to practice; Johnson to November 30, 1932, as date of conception, and January 14, 1933, as date of reduction to practice. It appeared that Johnson's patent application had been complete on the former date, but had not been filed until the latter date. A party is not charged with lack of due diligence until his opponent has entered the field. Thus, Johnson had to explain his inactivity between December 8, 1932, and January 14, 1933, a period of only about five weeks.

In explaining his inactivity, Johnson testified that he was vice-president of a large corporation, and its director of engineering. He further testified that, after returning from Europe (December 1, 1932): "I stayed in the East several days, then came back and found my desk piled up about a foot thick with all sorts of urgent matters. I was called back to New York for some important conferences, then came back for a few days and returned to New York for the Christmas holidays, staying through for the New York automobile show some time in January."

Johnson's counsel thought that in view of the many demands on his client's time and energy, the period of about six weeks to check and execute the involved application indicated a high degree of diligence. So did the Examiner of Interferences and the Board of Appeals; but the Court of Customs and Patent Appeals thought differently, and found as follows:

"A reasonable interpretation of the evidence is that Johnson did everything else he had to do —and took time off for the Christmas holidays and the New York automobile show—before he got around to considering the application, and that it was not until January 11, 1933, near the very end of the critical period, that he went over the application and signed it. We cannot see therefore, how it can be successfully contended that Johnson has proved that he was diligent during the critical period."

Five weeks does not seem a long period in a patent office procedure, considering that nine years elapsed between the filing of the applications and the final decision. Many an executive, therefore, might do well to revise his ideas on the question of "due diligence" in filing a patent application, thereby avoiding serious difficulties in regard to proof of priority of invention.

* * *

Study of Photo-Elasticity

The Eastern Photo-Elasticity Conference was held in Chicago, November 13 and 14, under the auspices of the Illinois Institute of Technology. A large number of papers dealing with the subject from many points of view were presented. Anyone interested in these papers should address Charles O. Harris, assistant professor of mechanics, Illinois Institute of Technology, 3300 Federal St., Chicago, Ill.

How the Experience of the Automotive Industry Has Aided War Production

THE contribution of the automotive industry in the simplification of the design and production of war equipment has meant a great deal in the speeding up of the war program. All the companies engaged in the automotive industry have made valuable contributions in this direction. The General Motors Corporation has published a few examples of what has been accomplished by its engineers and production men in developing wartime production technique, providing gains both in quantity and quality of war materials. Through these contributions, important savings in time, materials, and cost have been achieved.

Furthermore, employes in practically all departments of the industry, by their suggestions, have given valuable assistance; and manufacturers have cooperated with one another, and have been aided by Army and Navy engineers, without whom much of this progress would not have been possible.

Modern warfare, in its mechanical aspects, is a contest between industrial achievements—a struggle between the opposing forces in the attainment and maintenance of superiority in weapons. Quantity alone is not enough—there must be performance and superiority as well. To win this war, this Nation must see to it that its fighting men are supplied with not only more but also better weapons.

A few examples among the many achievements of industry in its effort to do things in a better and faster way will prove of interest. Stronger and lighter propellers for aircraft are now made by substituting hollow steel construction for solid aluminum blades. In this way, from 100 to 200 pounds of aluminum are being saved per propeller, according to its size, and 75 pounds are saved in the weight of the complete propeller assembly.

As a machining achievement may be mentioned the use of multiple-spindle drills to perform fourteen lapping operations simultaneously on liquid-cooled aircraft engines. In this way, the time has been reduced 80 per cent, compared with that required by the method formerly used. This means that production is about five times as great, and, incidentally, many important machines have been released for other work.

Sub-contracting plays an important part in the achievement of the automotive industry. Take the Oldsmobile organization as an example. Of the 132 parts in an aircraft gun, the prime contractor makes only three basic parts; the remaining 129 parts are made by fifty-three sub-contractors working under Oldsmobile direction. These sub-contractors already had the necessary manufacturing equipment, so that duplication of machine tools was avoided and the available equipment was used to best advantage.

Great savings in materials have been effected through changes that in no way affect the performance of the equipment being made. In one instance, head-lamp reflectors for war vehicles, previously drawn from brass and then nickel- and silver-plated, are now drawn from steel, enameled, and coated with "vaporized" aluminum. In this way, great quantities of scarce copper are saved, in addition to a saving in nickel. Steel, while not available in abundance, is still not so critical a material as copper. In the manufacture of head-lamps for 100,000 vehicles, the old type of lamp required 65,000 pounds of copper; 32,000 pounds of zinc; 275 pounds of nickel; and 160 pounds of silver. The new type requires 78,000 pounds of steel, and only 5 pounds of aluminum.

At one of the Buick plants, a newly designed electric welding machine makes it possible to speed up the welding of Diesel-engine crankshaft balancers from three to thirty-six per hour. At the Cadillac plant, supercharger rotator vanes are now made in 10 man-hours instead of 125, and nearly 500,000 pounds of materials are saved per year.

The production of war materials in the entire automobile industry has grown to enormous proportions. Taking the case of General Motors alone, we find that the deliveries of war materials in the third quarter of 1942 were more than five times as great as in the third quarter of 1941. This is production as expressed in dollar value; but war production increases even faster in actual physical volume, because prices tend downward as manufacturing efficiency and output increase.

These achievements of industry, accomplished in spite of many retarding influences, some due to Government regulations and some to national labor policies, are so noteworthy that it is not surprising that the Army and Navy have found it fitting to accord many of the automotive plants the Army-Navy "E" for excellence in production. As stated in the General Motors report for the third quarter of 1942, "There is but one objective—more and better fighting materials, faster."

Air-Conditioned Room Insures

Air-Conditioning Insures that Gages Made to Specified Dimensions in the Summertime will be the Same as Similar Gages Produced During the Winter Months

By CHARLES O. HERB

MEN experienced in the machining, inspecting, and assembling of metal parts made to close tolerances are well aware of the difficulties that may arise from finishing a part at a certain room temperature and checking or assembling the part at an appreciably higher or lower temperature. If the part is made of brass, aluminum, or cast iron, for example, there will be a considerable difference between the expansion or contraction of the work and that of the alloy-steel gage employed for its inspection, or of parts of other metals into which it is to be assembled.

Many gage manufacturers, therefore, perform finishing operations on gages in departments maintained at a constant temperature the year round. Thus a gage made in one of these rooms to a specified dimension on the coldest day in January will be of exactly the same dimension as a similar gage finished on the hottest day in July, and not several ten-thousandths of an inch smaller.

The Axelson Manufacturing Co., Los Angeles, Calif., has for years produced many types of gages for the interchangeable manufacture of oil-pumps and other oil-field equipment, as well as gages required in the building of heavy-duty engine lathes. On the basis of this experience, the concern was able to accept large contracts from our own government and others of the United Nations for gages required in the manufacture of war munitions. The large gage volume going through the shop warranted the construction of a separate air-conditioned gage room comparable to those of plants devoted exclusively to gage manufacture. All grinding and checking operations on gages are performed in this air-conditioned room, and in addition, all lead-screws for Axelson engine lathes are thread milled in this department to insure the

Quality Gages for War Work

highest possible accuracy. The room is 70 feet long by 30 feet wide. It is the largest air-conditioned room on the Pacific Coast in use for the purpose mentioned. The height from the floor to the ceiling is 10 feet. The temperature in this room is maintained at 68 degrees F. within 1 degree the entire year around. The humidity is also so controlled as not to exceed 50 per cent.

Such close control is essential because on a 6-inch thread gage, for example, a difference in room temperature of only 7 1/2 degrees would cause the gage to expand or contract more than the specified tolerance of 0.0003 inch. On thick, solid parts, the expansion or contraction would, of course, not be so great as on gages designed with thin webs and lightening holes.

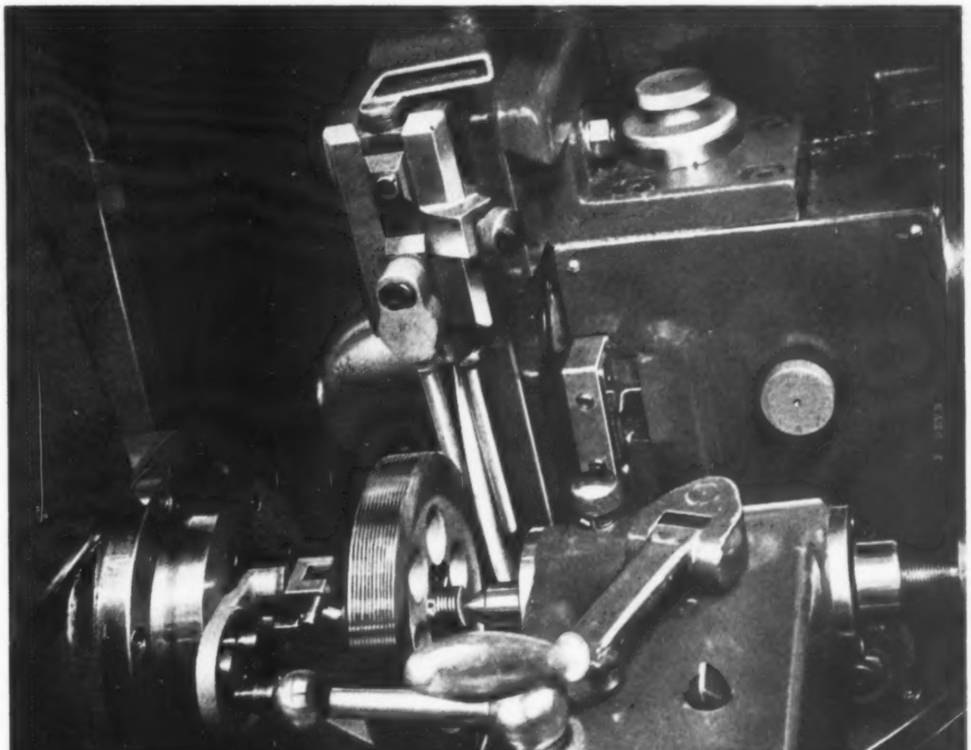
Conditioned air is constantly delivered through a duct that extends along the ceiling in the middle of the room, as seen in the heading illustration, and discharged through three draftless air diffusers. Outgoing air is discharged through a grill in the wall at one end of the room. Depending upon the temperature of this outgoing air, a thermostat is actuated to operate the air-conditioning system so as to maintain the prescribed temperature. The more machines there are in operation, the more heat is created and the more frequently the ice producing compressor of the air-conditioning system must be operated. There is a complete change of the air in the room every three minutes. Double doors are provided at the room entrance to minimize temperature changes due to air coming in from the outside when the doors are opened and closed. A constant record of the room temperature is kept by a Foxboro temperature recorder.

The cooling of the air is effected by a compressor capable of making 25 tons of ice every twenty-four hours. The refrigerant is Freon. The air-conditioning equipment was installed by the Carrier Corporation.

This air-conditioned room is completely enclosed by insulated, windowless walls, so as to prevent the room temperature from being affected by the hot rays of the sun, and thus reduce operating costs of the air-conditioning system. Light is provided by over six hundred General Electric fluorescent tubes, of 40 watts each, which are arranged in three metal reflectors extending along the ceiling the full length of the room on both sides and in the middle. The light at bench height is equal to 50 foot-candles.

Tubes of different colors were installed to aid in discovering defects in the work. For example, "daylight" and white tubes are installed beside each other, and alternated from one end of the reflectors to the other. These tubes are interspersed at several points with green and blue

Fig. 1. Typical Thread-grinding Operation on a Large-diameter Gage in the Air-conditioned Gage Room of the Axelson Manufacturing Co.



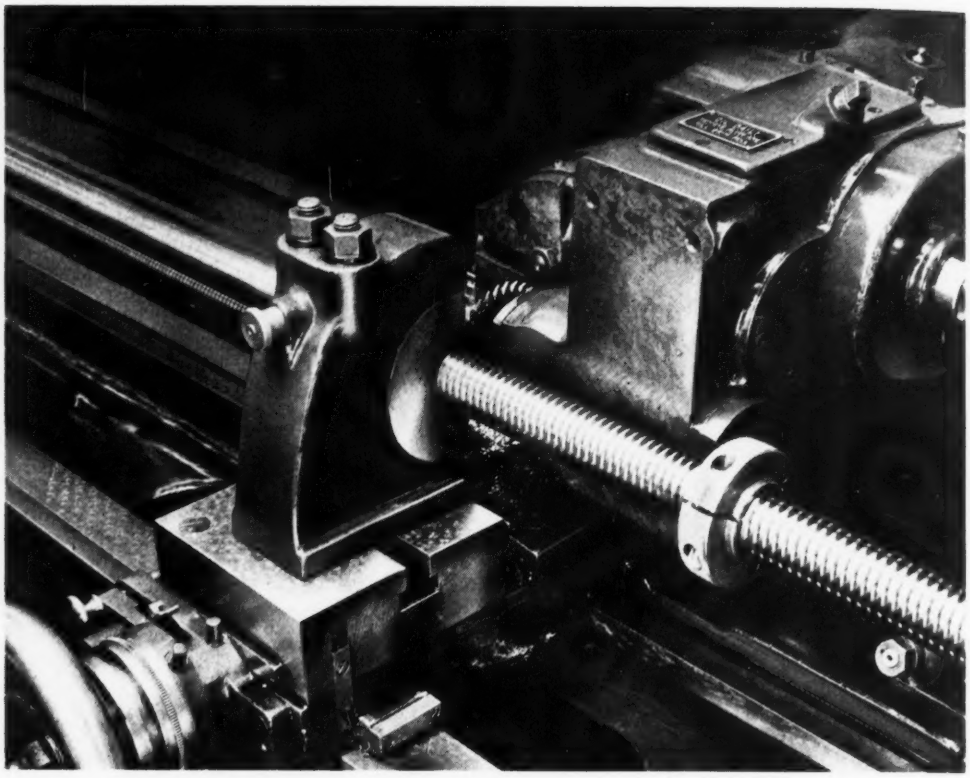
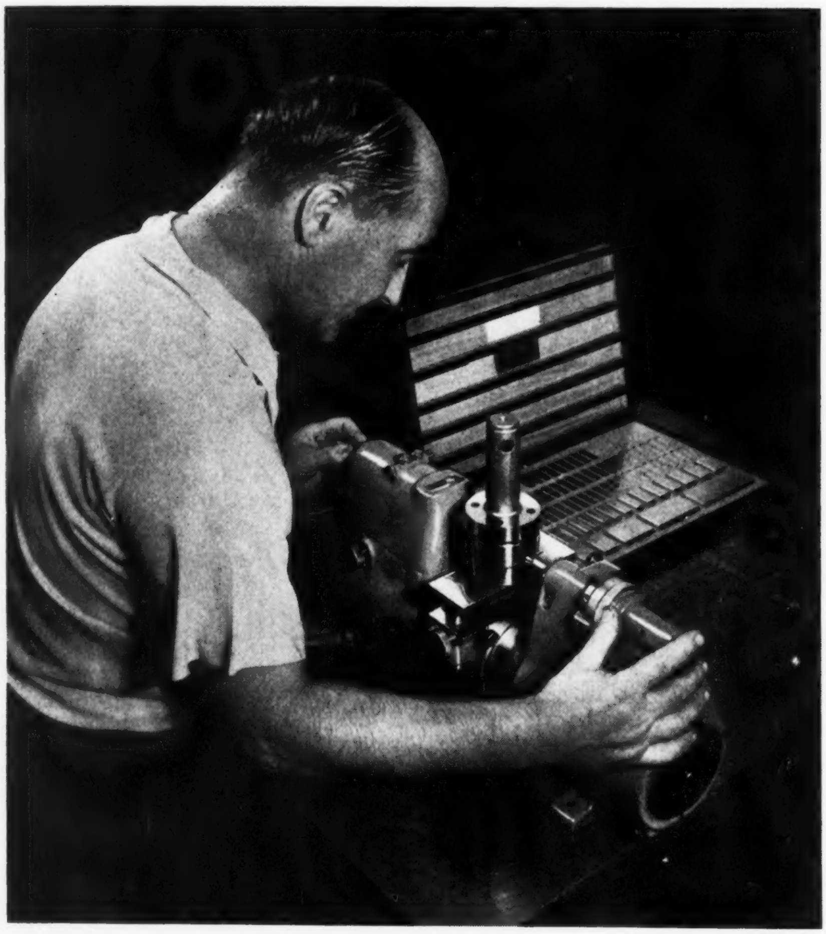


Fig. 2. Lead-screws for Engine Lathes are Thread-milled in the Air-conditioned Room Accurate as to Lead within 0.0003 Inch in 2 Inches at Any Point along the Screw

Fig. 3. (Below) Using a Super Micrometer for Determining the Pitch Diameter of a Thread Gage by the Wire System



tubes. Thus work can be tilted in the hands of the inspectors so that a green or blue band of light will be reflected on the part, which will quickly show up defects where the reflected color meets the normal reflection on the work. Artificial lighting avoids strong shadows, which is another advantage in inspection operations.

Thread gages are made in this department with threads as small as No. 10—thirty-two per inch; and as large as 10 1/4 inches in diameter—6 threads per inch. Threads as coarse as 12 per inch are ground from the solid, while coarser threads are precut, usually by chasing, before being hardened, and are afterward finished by grinding. Thread-grinding operations are performed on a Jones & Lamson or on an Ex-Cell-O thread grinder, a typical operation being shown in Fig. 1.

Lathe lead-screws are threaded on a Pratt & Whitney or on a Lees-Bradner thread milling machine, the practice being to use a single milling cutter, as shown in Fig. 2, and to cut the thread to full depth with one pass of the cutter along the

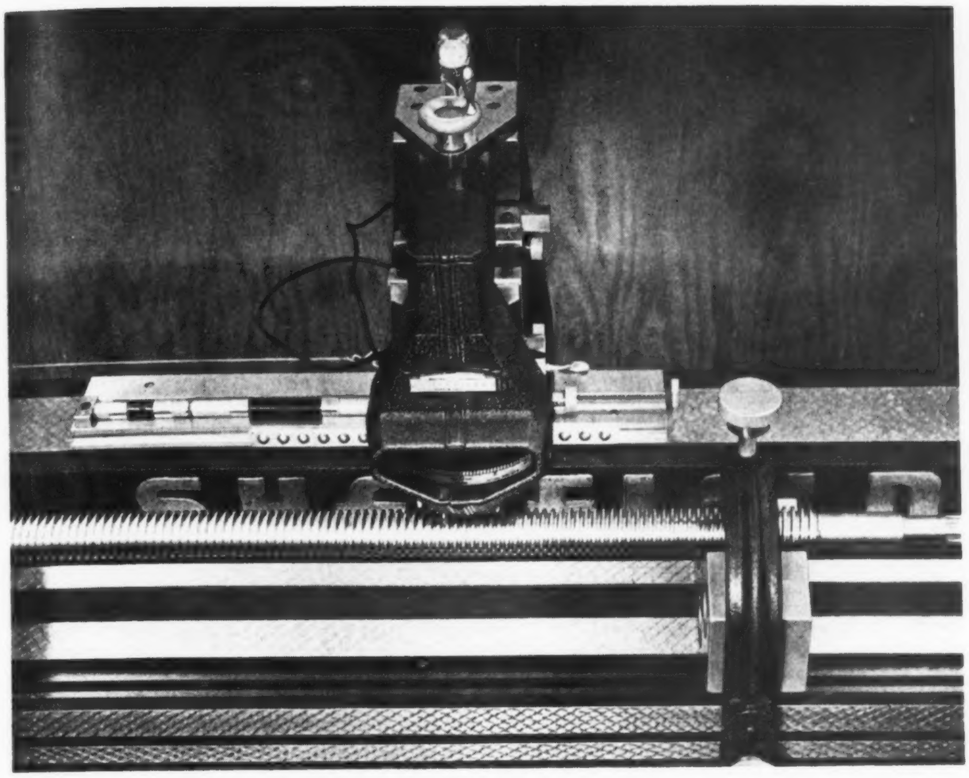


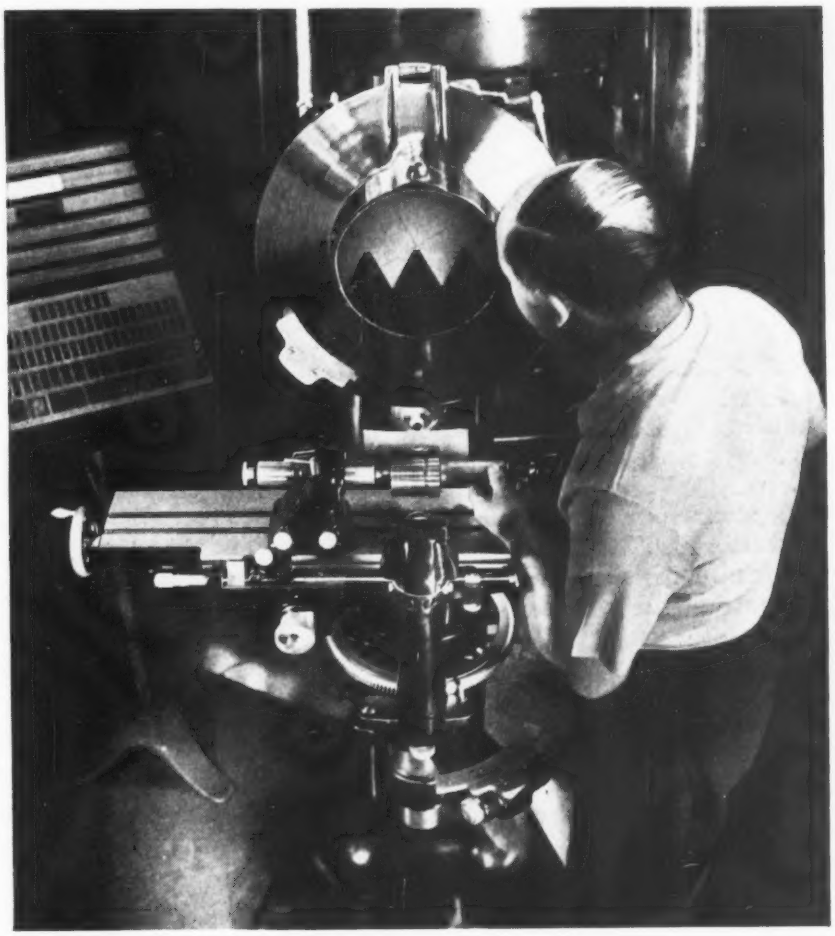
Fig. 4. The Accuracy of the Lead on Lathe Lead-screws is Determined by a Sheffield Lead-checker, Provided with a Visual Gage, and End Measuring Rods and Gage-blocks

work. The tolerance on the thread lead is ordinarily 0.0003 inch in a length of 2 inches at any point along the screw, or 0.001 inch in a length of 12 inches, but actually the lead-screws are cut considerably more accurately than this. Lead-screws up to 42 feet have been produced.

The accuracy of the lead on these screws is verified by means of the Sheffield lead-checker illustrated in Fig. 4, which is provided with a visual gage mounted on a ball-bearing slide. This slide is movable on a way which can be positioned at various points at the back of a long bed. In an inspection, a pointer mounted on a vertical slide at the front of the gage is brought into contact with one side of the thread at the point to be checked, after which the visual gage is so adjusted that a shadow appears across the gage scale at the zero point.

Then the pointer is raised and the gage-slide is moved horizontally an amount corresponding with the distance to be checked. This distance is determined by placing end meas-

Fig. 5. A Jones & Lamson Comparator is Used to Inspect the Thread Form on Gages and to Expose Minute Defects



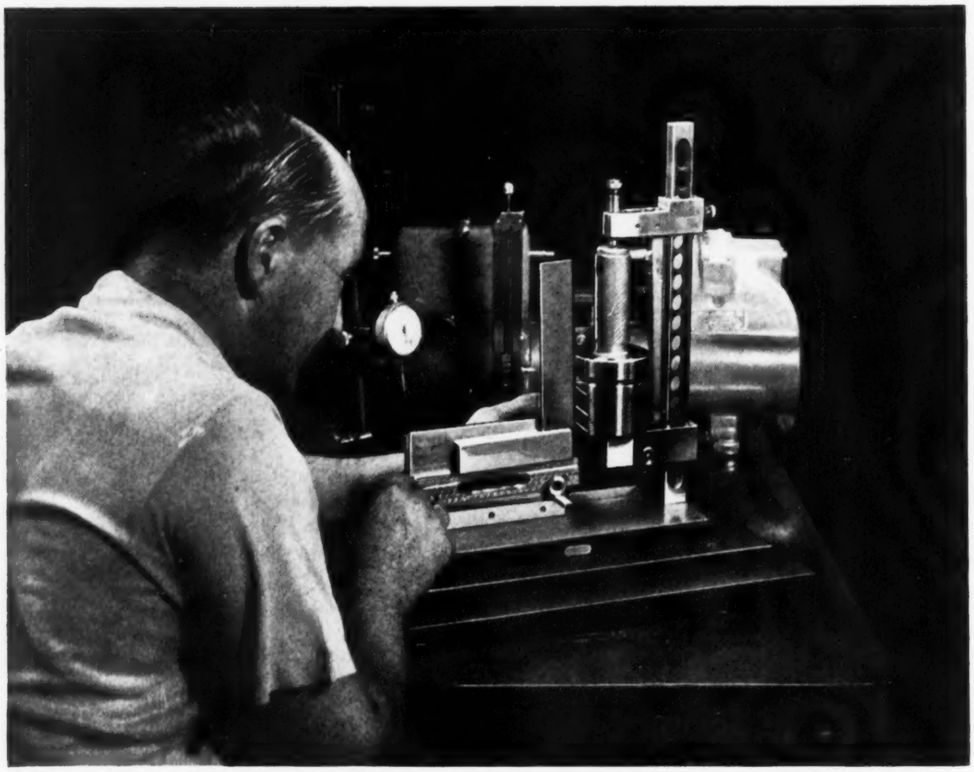


Fig. 6. Checking the Taper of a Pipe-thread Gage by the Use of a Sine Bar and a Steel Square

uring rods and Johansson gage-blocks between a hardened and ground locating block at one end of the way on which the gage slides and a second hardened and ground block on the side of the gage-slide. By again lowering the pointer against the side of the thread as before, but at a different location along the screw, and observing the position of the shadow on the gage dial, the amount of any error in the lead can easily be determined. The gage scale is graduated to 0.0001 inch, and readings to about 0.000025 inch can be readily approximated. The same visual gage is employed for checking the lead of thread gages.

Diameters of plain and thread gages are inspected either by using another type of visual gage, which is graduated to 0.00005 inch, or the Pratt & Whitney Super Micrometer shown in Fig. 3. In the case of thread gages, wires are placed in the threads, and readings taken on top of the wires in the conventional manner. The inspector also uses super-sensitive dial gages, provided with frictionless spindles and means for quickly adjusting the indicator arms vertically.

The thread form of gages is checked by means of a Jones & Lamson comparator, a typical inspection being illustrated in Fig. 5. Magnifications of 10X, 31 1/4X, and 62 1/2X are commonly used. The angles of thread sides can be checked within two minutes, and minute defects can be instantly observed.

Fig. 6 shows an inspector checking the taper on a pipe-thread gage of a type widely used in the oil fields. The gage is supported vertically between centers, and the inspection is conducted by bringing a steel square in contact with three wires inserted in the threads of the gage. The bottom edge of the steel square rests on top of a sine bar which has previously been set to the required angle of taper. Accuracy of the sine-bar setting is insured by placing a Johansson gage-block of the required thickness under the roller at the raised end of the sine bar.

Van Keuren light-wave equipment is available for checking the accuracy of gage-blocks, and there are other inspection devices of high accuracy. A Swiss jig boring machine is also installed in this air-conditioned room to facilitate close location and drilling or boring of holes in jigs and fixtures.

* * *

Economizing on Electric Motors

A 20-page booklet entitled "Calling All Horsepower" has recently been published by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. This booklet, prepared at the suggestion of the War Production Board, points out how motor overload capacity can be used to get more production from every available motor, and at the same time, effect large savings in critical materials. Six wartime application recommendations are discussed. Charts and illustrations give specific information on the pounds of war material that can be saved by each method.

Machining Laminated Phenolic Plastics

By F. P. HUNSICKER
Sales Division, Trafford Micarta
Westinghouse Electric & Mfg. Co.

LAMINATED phenolics, such as Micarta, manufactured by the Westinghouse Electric & Mfg. Co., are heavy-duty, thermosetting plastics made from cloth or paper impregnated with synthetic resins and compressed under heat into a permanently solid substance with high mechanical and electrical properties. They are made in plate and structural forms, and can be molded to simple shapes. In a great many applications of these materials, simple shapes are more economically machined from plate or structural forms than molded complete. This is particularly true when quantities are not sufficient to warrant mold investments.

Laminated plastics were rapidly finding their way into industrial applications before the existing emergency. Now, with acute shortages in metals and rubber, their use is expanding even more rapidly. They have many outstanding characteristics that make them suitable for use in place of metal or rubber parts, and although their first cost may be higher in many cases, final economy is often greater, because of their excellent performance.

Some of their properties are as follows:

Corrosion Resistance—Laminated phenolics are not affected by acids and alkalies up to 10 per cent concentration. Conditions of continued exposure to high humidity, oils, gasoline, or mildly corrosive fumes will not impair their usefulness.

Moisture Resistance—The moisture resistance of phenolic laminates is such that the material is not subject to excessive swelling or warpage.

Light Weight—Laminated phenolic plastics are light, weighing approximately one-half as much as aluminum of equal strength. The average density is 0.05 pound per cubic inch.

High Strength—The mechanical strength of these materials is sufficient for a great many structural parts in all kinds of machinery. In compression, pound for pound, they are as strong as structural steel. In comparison with other types of plastics, the impact strength of laminated phenolics is very high.

Noise Elimination—Owing to the resilience of laminated phenolics, they absorb vibration and deaden and reduce noise. For this reason, they are frequently used for gears where quiet operation is an important factor.

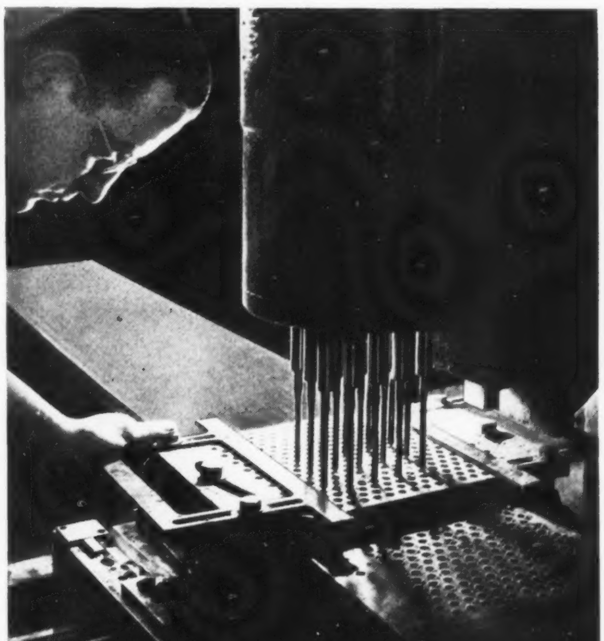


Fig. 1. Drilling Suction Holes in a Laminated Phenolic Suction Box Cover for a Fourdrinier Paper Machine

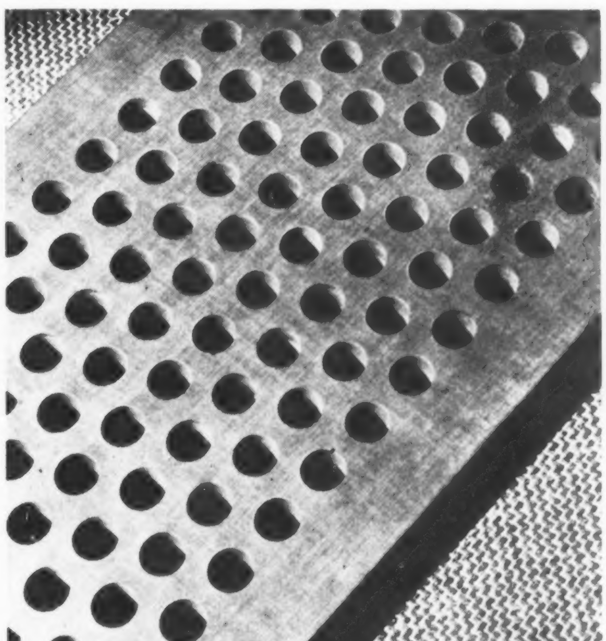


Fig. 2. Close-up View of Suction Box Cover being Drilled in Fig. 1, Showing Excellent Finish Obtained

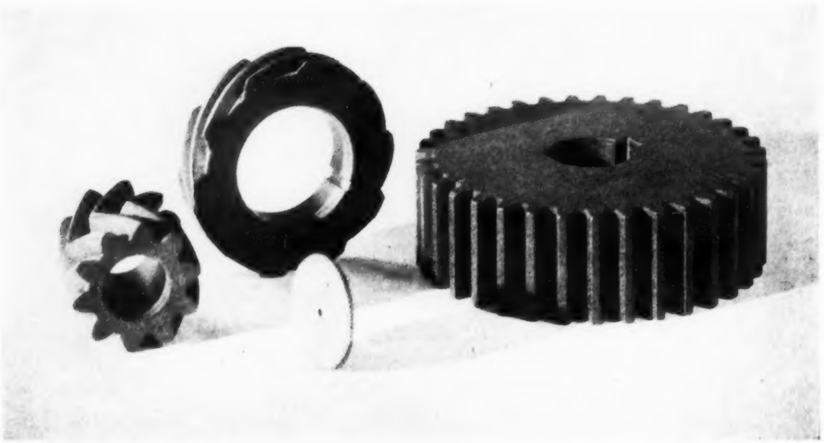


Fig. 3. Laminated Phenolic Gears that have been Formed Completely by Machining

Ease of Machining—These materials can be machined with ordinary machine tools at about the same speeds and feeds as brass.

The illustrations accompanying this article show drilling and turning operations being performed on laminated phenolic plastics, and examples of various finished machined shapes.

Punching and Shearing Operations

Most grades of laminated phenolics can be punched either hot or cold. The die must be kept sharp, however, in order to produce good results. The minimum clearance between individual punchings, and also between punchings and the edge of the material strips, should be about three times the thickness of the material.

For hot punching or shearing, the material is heated in a steam or electric oven, designed to give a uniform temperature throughout the heating chamber. The material is left in the oven just long enough to be uniformly heated to oven temperature. Further heating causes brittleness. Temperatures of 100 to 120 degrees C. (212 to 248 degrees F.) are recommended. The heating time ranges from five minutes for 1/16-inch material to thirty minutes for 1/4-inch material.

Dies for punching laminated plastics are designed the same as for punching metal, except that smaller clearances are allowed between punch and die. In cold punching, this clearance is small, approaching a "sliding fit." The strippers are close fitting and backed with strong springs.

Because these materials expand after being compressed in a die, blanks will be larger than the die diameter and holes will be smaller. On hot punchings, allowance should be made for shrinkage of the material after punching. This shrinkage varies with the grade of material, thickness of piece, and the temperature of the material during the punching operation. For very small holes and blanks, allowances for shrinkage are often neglected, while for large pieces and accurate work, they must be carefully considered. As an example, suppose a 1-inch diameter hole is to be punched hot in 3/32-inch thick stock; this would require a die of 1.009 inches and a punch of 1.007 inches in diameter. If this piece is punched cold, however, the die should be 1.005 inches in diameter and the punch 1.003 inches in diameter.

Shears suitable for thin metal sheet are used for cutting laminated plastics. The knife must be kept sharp. In trimming paper-base grades cold, clean-cut edges are obtained with thicknesses of 1/32 inch and under, and when trimmed hot, up to 1/8 inch. Fabric-base grades are trimmed cold up to 1/16 inch, and hot up to 1/8 inch. Greater thicknesses can be sheared if the condition of the edge is not important.

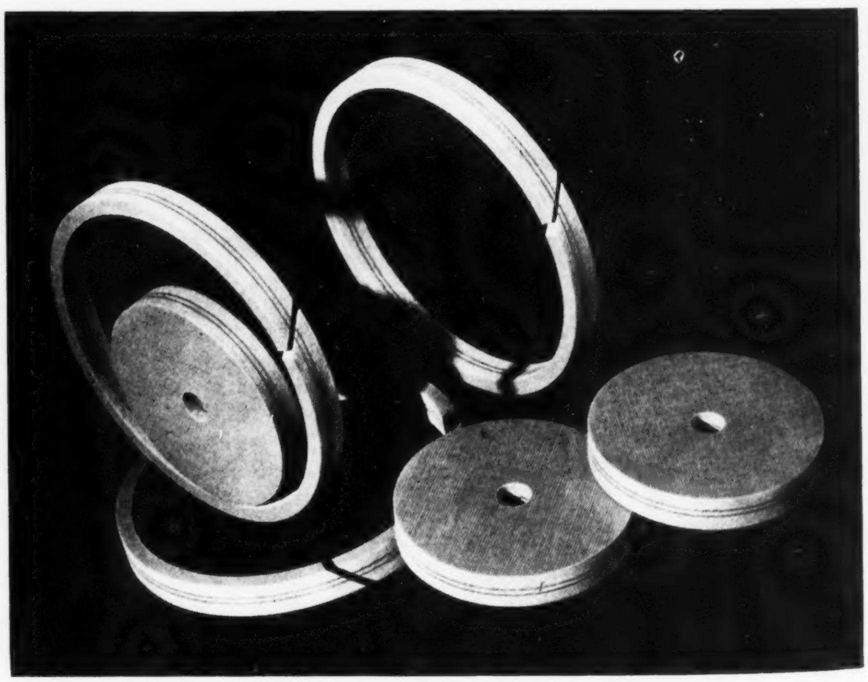


Fig. 4. Piston-rings and Valve Disks Machined from Laminated Phenolic Plate

Suggestions for Machining Operations

Care must be taken in all machining operations to avoid local overheating. A temperature of over 150 degrees C. may damage the material. Dry machining is used, a cutting compound or lubricant being unnecessary. Chips should be removed by suction.

Turning — High-speed steel cutting tools are used for turning, and the work is rotated at a speed of 200 to 400 feet per minute. When both roughing and finishing operations are used, the high-speed steel tool is essential only for the finishing operation. About 0.010 inch of stock should be left for finishing. Feed should be adjusted by operator to avoid overheating and "burning" material.

Sawing — Material up to 1 inch thick is cut with a 12- to 16-inch circular saw at about 3000 R.P.M., and material 1 inch thick and over, with a 16-inch saw at about 2400 R.P.M. The saw used for roughing cuts has bevel teeth, seven to the inch, while a smooth saw, with no set — similar to that for metal — is used for finishing cuts. For use on all thick material, the saws should be hollow-ground to prevent binding. The smaller the projection of the saw above the material on the sawing table, the better will be the sawed edges. A thin sheet of plastic or other material placed under the piece to be sawed, is of advantage when extreme smoothness of cut is desired.

A band saw is used for sawing round blanks from plate stock. The usual band saw is of the bevel-tooth type, with some set, and has three to seven teeth per inch. It is run at 3000 feet per minute. When circular cuts are taken, the width of the saw is small, but in making straight cuts, the width of the band saw blade may be up to 1 inch—the wider the better.

Thickness Limits for Punching

Type of Composition	Maximum Recommended Thickness	
	Cold	Hot
Paper Base	3/64 inch	1/8 inch
Fabric Base	1/8 inch	1/4 inch

Drilling and Tapping — Drilling at right angles to the laminations is done with a standard drill which has the lips backed off sufficiently to provide plenty of clearance. The drill is lifted frequently from the work to prevent excessive heating and consequent dulling. The speed of the drill is considerably in excess of that used on soft steel. With tungsten-carbide tips, speeds as high as 16,000 R.P.M. may be used. The rate of feed will be determined by the operator, and care must be taken to avoid forcing the drill too fast and "burning" the material.

In drilling laminated plastics parallel to the laminations (which is done only in the case of fabric-base materials), care must be taken to prevent splitting. The material is clamped in a

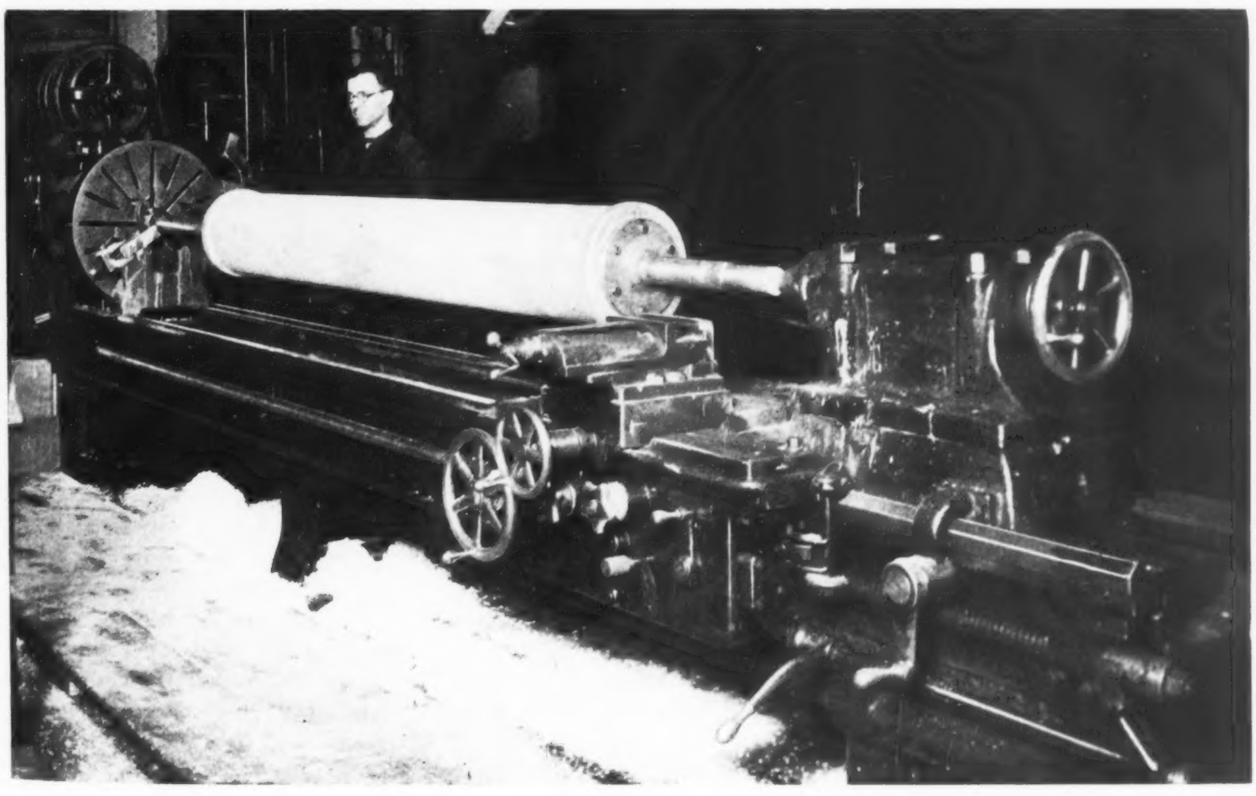


Fig. 5. Turning Outside of Large Laminated Phenolic Tube

vise or between plates. A "flat" or "bottom" drill is used at about the same speed as for drilling at right angles to the laminations, but with a slower feed. For drilling holes of 3/4-inch diameter or over, the material may be chucked in a lathe and a boring tool used for removing the stock. The methods suggested for drilling are also recommended for tapping.

Threading — In cutting a 60-degree thread, it is always advisable to swing the compound rest on the lathe to a 30-degree angle. The tool is ground to cut on one side only. For all other threads, standard methods are used with satisfactory results, the speeds and feeds being similar to those used in threading soft steel.

Milling — In milling, a standard tool is used at speeds and feeds similar to those used on bronze or soft steel. The cutting angle of the milling cutter, if ground with a slight rake, will give better results.

Buffing — The ordinary standard polishing rouge on a rag wheel works satisfactorily on material requiring a polished surface.

Some variations from the recommended procedure may be desirable, depending on the work being performed. However, wide experience has shown the suggestions given here to be most practical. In conclusion, it may be said that laminated plastics should not be thought of simply as substitutes for other materials, but also as new materials with their own individual characteristics and advantages.

War Material Must be Properly Packed for Shipment

REFERRING to the editorial that appeared on page 208 of November MACHINERY, a man who has had a great deal to do with the proper packing of ordnance material writes us as follows:

Probably one of the most important considerations, and one that is easily overlooked by the average manufacturer, is that his production is of very little value unless the war materials and equipment that he is making are delivered to combat troops in usable condition. There has been so much emphasis on production techniques that, in many cases, proper packaging has been neglected.

In recent months, however, an improvement is discernible, but the millennium is far from here. Proper packaging, preparation, and preservation will result in supplies reaching "the fronts" in fighting trim; but often a great deal more than that can be accomplished. If packaging is scientifically devised, it can, in effect, "build ships." It can fuel them and man them, and these "ships" require no more critical materials than the packages themselves, because they are "ships" that don't have to be built.

The Armed Forces call this the logistical aspect of the problem—when packages are properly designed, savings in *useless* weight and cubic displacement reflect a *net increase* in the amount of usable ammunition, supplies, and equipment that reaches the doughboy trudging through the arid wastes of Africa or the airmen knocking "Zeros" out of the blue Pacific sky. The longer our supply lines are, the greater is the strain on our transport. We must make every ounce of transport count by delivering bullets, fuel, spares, and food—not lumber or paper or nails.

As General Campbell, Chief of Ordnance, says, "Industry has a golden opportunity to build ships in its own back yard." Adding to the amazing work that has been done in the shipyards of this nation, our war production industry has the opportunity of materially increasing the effectiveness of the shipbuilding program by insuring that its war products and essential civilian products are adequately protected in shipment. To use any more material or space than is essential to do the job, or any less, will result in our invaluable military supplies arriving at their destination either reduced in quantity or sabotaged by damage.

The present transportation hazards of our globe-encircling supply lines are beyond anything previously experienced, either in war or in industry. Our ships must pass through every imaginable weather condition. Severe temperature changes are encountered. Condensation is a great problem. The corrosive effects of salt-laden air are at work all over the globe, and the drenching humidity of steaming jungles can be as effective a handicap to an operation as the Axis Powers. The problem is a gigantic one, and one that will take the concerted effort of every packaging engineer in the land.

In order to provide a sound foundation for this work, the Armed Forces and War Agencies are preparing packaging specifications designed to meet the fundamental requirements of military packaging. Every item of supply has not yet been covered, but the broad principles have been laid down, and individual requirements are being taken care of as rapidly as possible. These fundamental requirements will not, in every case, meet the individual needs under all the unpredictable circumstances of this war, but they give a base line against which to make adjustments as conditions change and new and better methods are discovered. It will enable us to "stay on the beam."

High-Speed Steel Tools Tipped by Braze-Hardening and Braze-Tempering*

By B. S. LEMENT, Metallurgist and
W. B. KENNEDY, Production Superintendent
Watertown Arsenal, Watertown, Mass.

THE possibility of making cutting tools by joining high-speed steel tips to low-alloy steel shanks has been investigated at Watertown Arsenal as one means of conserving high-speed steel. Success along these lines with carbide-tipped tools indicated that brazing might also be applied to the tipping of tools with high-speed steel. Brazing media for carbide-tipped tools are copper, Tobin bronze, and silver solder. The shanks are generally made of low-alloy steels having carbon contents ranging from 0.40 to 0.60 per cent. A wide variety of steels may be used, but a silicon-manganese steel of the chisel steel type has been found to possess the best all-around properties. Carbide tips are usually copper-brazed in a furnace having a suitable reducing atmosphere, although an oxy-hydrogen torch with excess hydrogen is occasionally used. Silver-brazing of carbide tips is mainly accomplished by means of an oxy-acetylene torch.

To apply copper-brazing to the tipping of tools with high-speed steel, it is necessary that the brazing operation be carried out at a temperature that will permit satisfactory hardening of the tip. Molybdenum high-speed steels are suitable, since they have a hardening range of 2150 to 2250 degrees F. or 170 to 270 degrees F. above the melting point of copper. By soaking the tip in this temperature range, allowing the copper to set by cooling in air, and finally quenching in oil, the tip will be brazed to the shank and also will be hardened. This method has been called "braze-hardening."

*Released for publication by the Chief of Ordnance, U. S. Army. Statements and opinions are to be understood as individual expressions of the authors, and not as those of the Ordnance Department.

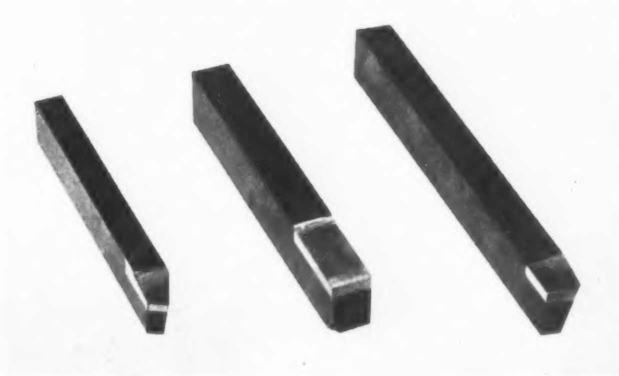


Fig. 1. Braze-hardened Molybdenum High-speed Steel Tipped Tools

Braze-hardening may be carried out in a commercial furnace designed for the copper-brazing of carbide tips. At Watertown Arsenal an electric furnace provided with a semicircular muffle made of heat-resisting alloy is used. The furnace is designed to apply localized heat only to the portion of the tool to be brazed. A hydrogen atmosphere is maintained inside the muffle to prevent oxidation.

Procedure Followed in Braze-Hardening

The procedure found satisfactory for tipping lathe tools with molybdenum high-speed steel involves several steps. The joining surfaces of the unhardened tip and shank are first cleaned by immersion in carbon tetrachloride. The end of the shank to be tipped is covered with a commercial, powdered, copper-brazing flux, and the tool is pushed partly into the muffle of the brazing furnace. When the flux has melted and

Fig. 2. Materials Used in Copper-brazing High-speed Steel Tip to Low-alloy Shank

Fig. 3. Materials Used in Silver-brazing High-speed Steel Tip to Low-alloy Shank

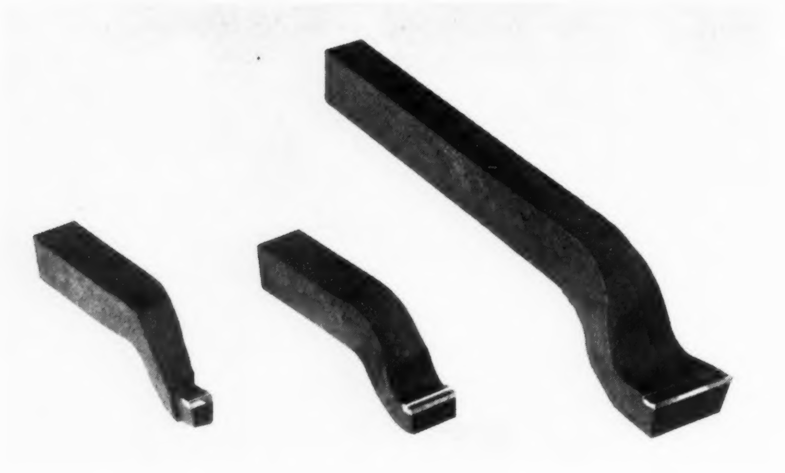


Fig. 4. Braze-tempered High-speed Steel Tipped Tools

spread over the surface, the shank is withdrawn from the muffle. The tip and shank are then fitted together with strips of copper in between and on top of the tip, and additional flux is applied.

The assembled tool is next moved partly into the muffle, in order to preheat the tip. When the tip has attained a temperature of approximately 1500 degrees F., the tipped end is moved into the high-heat portion of the brazing furnace operating at 2225 degrees F. In being heated to this temperature, the copper on top of the tip melts and actually flows in between the tip and shank, so that brazing occurs.

After allowing the tip to soak for a sufficient time at 2225 degrees F. to insure satisfactory hardening, the tool is withdrawn from the muffle and the tip is pressed firmly into place, either by tongs or in a press, in order to squeeze out any excess copper or flux. When the copper sets, the tipped end is quenched in oil to below 200 degrees F. As a result of this procedure, which takes less than twenty minutes for each tool, the tip is in a hardened condition and brazed firmly to the shank. It is necessary to temper the tipped tool at 1050 degrees F., as is done with a hardened solid high-speed steel tool, in order to develop secondary hardness.

Three molybdenum high-speed steel tipped tools are shown in Fig. 1. The assembly used in copper-brazing a tool 9 inches long, 1 1/4 inches high, and 5/8 inch wide is illustrated in Fig. 2. A folded copper strip having a total thickness of 0.01 inch is placed on the tip, and a single strip of copper 0.002 inch thick is placed between the tip and the shank. After braze-hardening and tempering at 1050 degrees F. for two hours, a hardness survey was made. The tip had attained a uniform hardness of about Rockell C 65, while hardening of the shank had occurred for a distance extending back about 5 inches from the front of the tool.

Silver-brazing can also be employed in producing high-speed steel tipped tools, but the low melting point of commercial silver solder (about 1200 degrees F.) prohibits using the same procedure as with copper-brazing. However, by using previously hardened tips, it is possible to braze the tip and temper it simultaneously. Since the melting point of silver solder is higher than the usual tempering temperature of high-speed steel, it is imperative that very short brazing periods be employed to avoid over-tempering and consequent softening.

Any high-speed steel composition may be used for tips. Special compositions such as high-carbon, high-vanadium, high-speed steel and cobalt high-speed steel are particularly suited to this method, however, since they have greater resistance to softening in tempering than the ordinary high-speed steels. This method has been termed "braze-tempering."

Method of Braze-Tempering

In braze-tempering, the joining surfaces of the shank and the hardened high-speed steel tip are thoroughly cleaned and covered with a commercial silver brazing flux, made in paste form. The tip is fitted on the shank with an intervening strip of silver solder 0.003 inch in thickness. The assembled end of the tool is then heated by playing the flame of an oxy-acetylene torch along the bottom until the heat soaks through the shank and melts the silver solder. Care must be taken to avoid over-tempering the tip, by minimizing the time between melting and solidification of the silver solder. During this time, the tip is pressed firmly in place.

When the silver solder sets, the tipped end of the tool is quenched in oil for a few seconds to reduce the temperature of the tip below 1000 degrees F., where effective tempering ceases. The tool is removed from the oil and allowed to cool in air in order that transformation of the austenite in the hardened high-speed steel tip may occur more uniformly and with less danger of cracking the tip.

The result of this procedure, which takes about fifteen minutes for an ordinary size tool, is that the tip is tempered and, at the same time, brazed firmly to the shank. Subsequent tempering at 1050 degrees F. for one hour is recommended as a means of relieving stress, and will have practically no effect on the hardness of the tip.

Three goose-necked tools tipped with high-carbon, high-vanadium, high-speed steel by the braze-tempering method are shown in Fig. 4.

The largest tool measures 20 inches in length and weighs 18 pounds, while its tip weighs only 2 ounces, or less than 1 per cent of the weight of the tool. The assembly used in braze-tempering is shown in Fig. 3. An investigation of the hardness of one of the braze-tempered tipped tools showed that the tip had retained its initial high hardness, and the hardness of the shank was unaffected, except directly below the tip, where the critical temperature was exceeded by direct contact with the oxy-acetylene flame, and the subsequent oil quench (followed by an air cool) caused hardening.

Comparison of Braze-Hardening and Braze-Tempering Methods

As compared with the braze-hardening method, the braze-tempering method is less suitable for tools required to take heavy cuts. In taking heavy roughing cuts, sufficient heat may be developed to cause softening of the silver alloy braze and consequent movement of the tip. For this reason, it is preferable to use braze-tempered tools mainly for finishing cuts. Since copper softens at a much higher temperature than silver solder, braze-hardened tools can be used to take either roughing or finishing cuts.

Another advantage of the braze-hardening method is that substantial hardening of the shank takes place, while in the case of the braze-tempering method the shank is relatively unhardened. This means that the braze-hardened tool shank is stronger and will have less tendency to take a permanent set due to bending in taking a heavy cut. Of course, the shanks of tools that are to be braze-tempered could be previously hardened to develop a strength equivalent to that secured in braze-hardened shanks, but an extra heat-treating operation is required.

In the case of braze-hardening, it is necessary that the shank steel possess resistance to excessive grain coarsening because of the high temperature involved. This is not necessary with braze-tempering, because the shanks are subjected to a much lower temperature.

Conservation of high-speed steel may also be accomplished by salvaging solid tools which have been discarded as under size. These tools may be annealed and then cut up into appropriate tip sizes. This method of conservation is very important in the case of special high-speed steel compositions, which will become more and more difficult to obtain as time goes on.

At Watertown Arsenal, both methods of brazing have proved successful, and high-speed steel tipped tools are being substituted for solid tools wherever possible. Thus far, these methods have been used mainly for lathe tools. The limiting factor in the application of these methods is the difficulty involved in brazing. Because of this, these processes would be of little advantage in making complicated drills or special shaped cutters.

Various methods of making high-speed steel tipped tools besides brazing are in use. These include mechanical fasteners, inserting, welding, and cementing. Some of these methods are comparatively new, and their relative advantages have not yet been established. However, any practicable method of producing high-speed steel tipped tools, if adopted on a nation-wide scale, would result in a considerable saving of strategic metals. This practice, therefore, is a patriotic duty, besides offering definite economic advantages.

* * *

Slide Films Demonstrate Carbide Tool Applications

In order to speed up the training of new workers in the use, care, and handling of carbide tools, the Carboloy Company, Inc., Detroit, Mich., has made available for general distribution a series of six educational 35-millimeter silent slide films. These films are completely self-explanatory, and are intended to enable users of carbide tools to increase production, save time, and reduce tool costs by a proper understanding of all the factors relating to their application.

The six films cover the following subjects: (1) What is Cemented Carbide? (2) Designing Cemented-Carbide Tools. (3) Brazing Cemented-Carbide Tools. (4) Chip-Breakers and their Application. (5) Grinding Single-Point Carbide Tools. (6) Putting Cemented-Carbide Tools to Work.

* * *

Calculating Machine Tool Power Requirements

A slide-rule known as the "Motorule," which simplifies the computation of the motor horsepower required for metal-cutting operations on various types of machine tools, has been developed by the General Electric Co., Schenectady, N. Y., and is offered free to machine tool users. The new device is expected to be of considerable assistance in assuring that the machines used in war work have the required motor capacity. It is of assistance, too, in the selection of motors for machines formerly driven from lineshafting. The slide-rule applies to a wide variety of cutting operations on lathes, drilling machines, milling machines, and planers. The operation of the slide-rule is simple. Complete instructions are furnished with each "Motorule."

MATERIALS OF INDUSTRY

THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

Plastic Pipe Replaces Iron Pipe in Many Applications

A new plastic pipe, manufactured in the same dimensions as extra strong iron pipe of 2-inch outside diameter or less, has been placed on the market by the Dow Chemical Co., 919 Jefferson Ave., Midland, Mich. The resistance of this pipe to extreme moisture, chemicals, and solvents, coupled with its strength and fatigue life, indicates that it will play a vital role in industry. In many applications, this new plastic pipe will undoubtedly be substituted for pipe made of strategic materials, such as vital metals and rubber, thus releasing these materials for more urgent needs associated with the war effort.

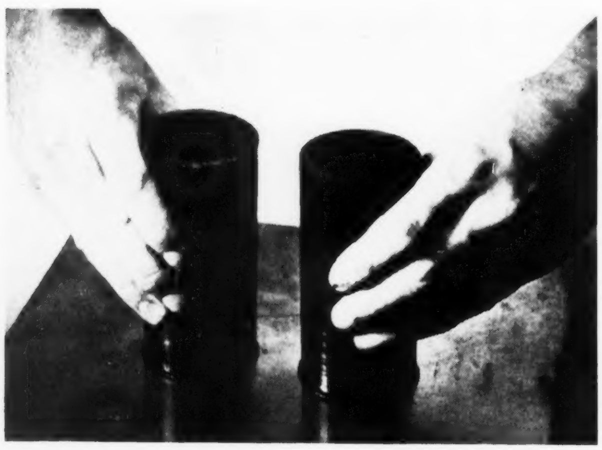
This revolutionary type of pipe is made of a new thermoplastic resin known as "Saran." The base resin is odorless, tasteless, and non-toxic. The plastic does not burn, and its toughness and abrasion resistance are of a high order. The retention of these properties upon aging insures excellent wearing qualities. This pipe is non-scaling and withstands freezing. Heat resistance is said to be excellent up to a temperature of 175 degrees F.

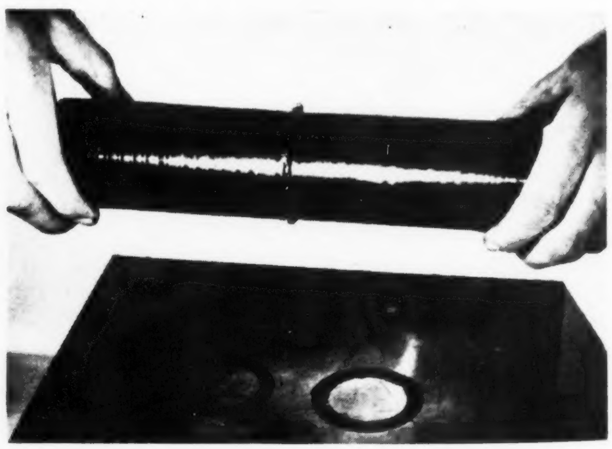
Saran pipe is produced in smooth, round, accurately sized lengths having dimensions identical with those of strong iron pipe. It can be readily welded, heated, and bent. The pipe can be cut with a wood saw or hacksaw, and threaded with ordinary iron pipe dies. 201

Temporary Transparent Coating to Protect Finished Surfaces

A transparent removable coating for metal and ceramic surfaces, known as "Protektol," has been developed by the Ault & Wiborg Corporation, Cincinnati, Ohio, with the object of reducing the number of products rejected because of rust, surface scratches, shop wear, grease, and dirt. Because it is transparent, the new coating permits visual inspection of the parts, and at the same time, affords protection during handling, fabrication, shipping, storage, and installation.

The liquid is applied by spraying, brushing, dipping, or roller-coating, after which it is air-dried, leaving a flexible glass-clear coating from 0.001 to 0.0015 inch thick. One gallon, when sprayed to a thickness of 1 mil, will cover approximately 250 square feet. The drying time, at 200 degrees F., is six to eight minutes.





Welding New Plastic Pipe is a Simple Operation. (Left) Pieces to be Joined are Placed on End against a Hot Plate Heated to 350 to 400 Degrees F., and Held until Material becomes Molten. (Right) Heated Ends are Then Placed Together in Proper Position, Pressed Firmly, and Allowed to Cool for Ten Seconds. The Entire Procedure Takes but Forty-Five Seconds, and the Resultant Weld is Said to Possess Greater Joint Strength than the Pipe Itself

To obtain additional information about materials described on this page, see lower part of page 214.

To remove the coating, it is only necessary to lift one edge and peel it, or blow it off with an air jet. The degree of adhesion is sufficient, however, to eliminate the possibility of accidental removal. The coating is water- and sunproof, and is not affected by most greases and oils. There is no deterioration or cracking at temperatures between 0 and 200 degrees F.

It is also available in colors, making it useful as a temporary identification medium. After being removed from the artical to which it has been applied, Protektol can be reduced to liquid form again. This reclamation process is very simple, and may be repeated. 202

Synthetic Corrosion-Resistant Compound

A synthetic, corrosion - resistant compound known as "Tygon," manufactured by the United States Stoneware Co., Akron, Ohio, is now obtainable in three forms, applicable in many fields. As a patent-leather like material, it can be applied in the form of a lining for process equipment; as a resilient compound, it can be formed into flexible sheets, tubes, and molded goods; and as a liquid, it can be sprayed, dipped, or painted on surfaces subject to corrosive action.

Tygon is resistant to practically all inorganic and organic acids, salt solutions, and alkalies. Unlike rubber, which it resembles in many physical characteristics, this synthetic material is unaffected by oxidizing agents and many of the hydrocarbons; in addition, it is not affected by any of the reagents that rubber resists satisfactorily. There is no limit to the size of the equipment on which this material can be applied, since no heating, baking, or vulcanizing is required. 203

Cellulose Wrappers Protect Armament Parts from Rust

In order to save valuable time spent in cleaning off grease or other rust - preventing compounds from armament equipment after delivery, a number of plants are now using a new tough, moisture-proof wrapping material. It is made of du Pont cellophane film, laminated to a light, cotton fabric known as "scrim," and then impregnated with other moisture - proof materials. It can be sealed either by twisting the ends of the package by hand or by using a heat-sealing device. The cellophane adds strength to the wrapper, and helps to make the material oil- and acid-resistant. This wrapper was developed by the Dearborn Chemical Co., 310 S. Michigan Ave., Chicago, Ill.

The "No-Ox-Idized" wrapper (so named because it retards oxidation or rust) is being used or tested on a variety of articles, including rifles, airplane propellers, aircraft guns, machine guns, ammunition, carburetors, bearings, gears, regular parts on the way to assembly points, spare parts shipped to zones of action, machine tools, and magnetos.

Before using the wrapper, the finished part is thoroughly cleaned of dirt and machining oils at the point of production. It is then wrapped in the cellulose material without any other protection against rusting except a light coating of oil, which in many cases need not be removed, or a lump of moisture-absorbing silica gel placed inside the wrapping. 204

Soft Plastic Developed as a Rubber Substitute

New soft forms of the plastic, ethyl cellulose, have been made available by the Hercules Powder Co., Wilmington, Del., as a rubber substitute with potential applications in products that, before the war, consumed 60,000 tons of rubber. These forms of ethyl cellulose, while not suitable for tires or inner tubes, may well be used for such products as gun covers, electrical tape, water tubing to replace brass, raincoats, hospital sheeting, garden hose, and other kinds of rubber hose, Mason jar rings, surgical tape, wire insulation, golf balls, impregnated fabrics, gloves, coated fabrics, and footwear. They are also said to be resistant to mustard gas—a property of value at this time.

All the components required for the manufacture of ethyl cellulose are domestic materials or materials obtainable in sufficient quantities for large-scale production, and include cotton linters or wood pulp, caustic soda, chlorine, and alcohol from natural gas or from fermentation of agricultural products.

The qualities of the various forms are toughness, pliability, flexibility, impermeability and thermoplasticity. The soft type mixtures can be made to retain good flexibility at temperatures as low as minus 70 degrees F., a temperature at which most plastics will shatter like glass upon impact. The properties that restrict the application of ethyl cellulose are its limited elasticity and a lower resistance to tearing than that of rubber.

Some forms of this plastic have quite good abrasion resistance and tensile strength sufficient for many uses. Water resistance comparable to that of compounded rubbers can also be built into these soft type cellulose plastics. Their resilience ranges from one-fourth to one-half that of various rubber samples tested, and their elongation, or stretch, has been found to be considerably less. 205

To obtain additional information about materials described on this page, see lower part of page 214.

Reconditioning Milling Cutters

Suggestions for Reclaiming Tools in General and Milling Cutters in Particular, with a View to Saving Important Tool Materials for War Production

By P. M. MATTHEWS
Time Study Supervisor, Factory Service Division
Westinghouse Electric & Mfg. Co.

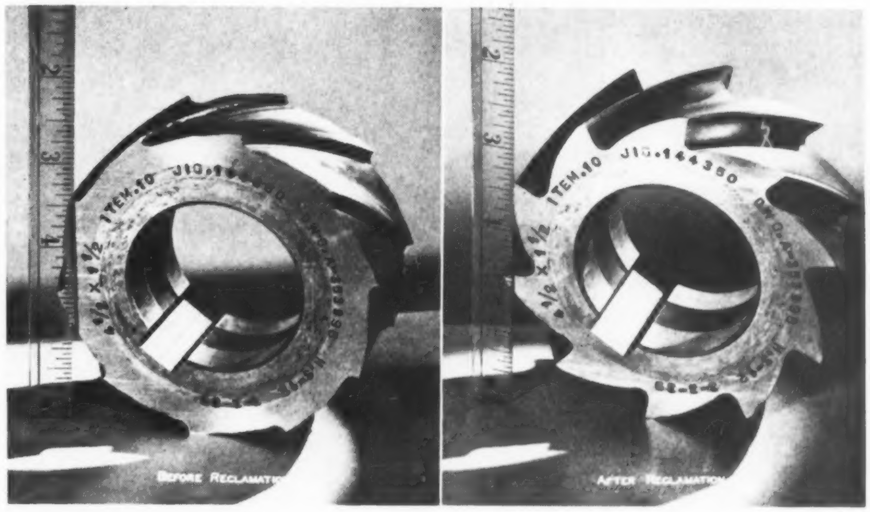
GOVERNMENT restrictions covering the use of high-speed steels in order to conserve tungsten, together with the present necessity for increased production schedules, have created a demand for cutting tools that is beyond the capacity of the cutting-tool industry. Manufacturers are ordering more machine tools, but these are useless without cutting tools. Salvaging programs, therefore, must reclaim worn and obsolete tools, in order that industry may be able to utilize existing equipment.

The possibilities of obtaining satisfactory tools by salvage have been recognized at the Westinghouse East Pittsburgh Works, and economical reconditioning processes have been developed. These have been applied for some time, and have proved to be quite satisfactory.

The reclaiming program was first thoroughly analyzed. Various methods were tried and comparisons of these methods made to determine the most desirable processing from an economical and quality standpoint. As a result, cutting tools to be reclaimed are first sorted and checked by the inspection department for defects beyond reconditioning. They are then graded and placed in one of four classifications: (A) Cutters that only need redressing; (B) cutters that need resharpening; (C) cutters that have to be recut for chip clearance ("cut in" necessary due to worn condition); (D) cutters that have to be "cut in" complete, due to broken or worn teeth (a great amount of grinding necessary to recondition).

In analyzing for these conditions, careful consideration is given to the relief, land, clearance, and finish, in order to utilize the most economical methods, so that during the resharpening operations, the least possible amount of material is removed from the cutting edges. The main object is to obtain maximum strength and cutter life.

The relief of the cutting edge should provide maximum support to the cutting edge, being just great enough to clear the work when eco-



Figs. 1 and 2. Worn Helical Plain Milling Cutter before and after being Reclaimed by Grinding

nomical feeds and speeds are used. This generally means a 0.003 - inch drop on a land 3/64 inch wide; or it may be individually governed by the application of the cutter.

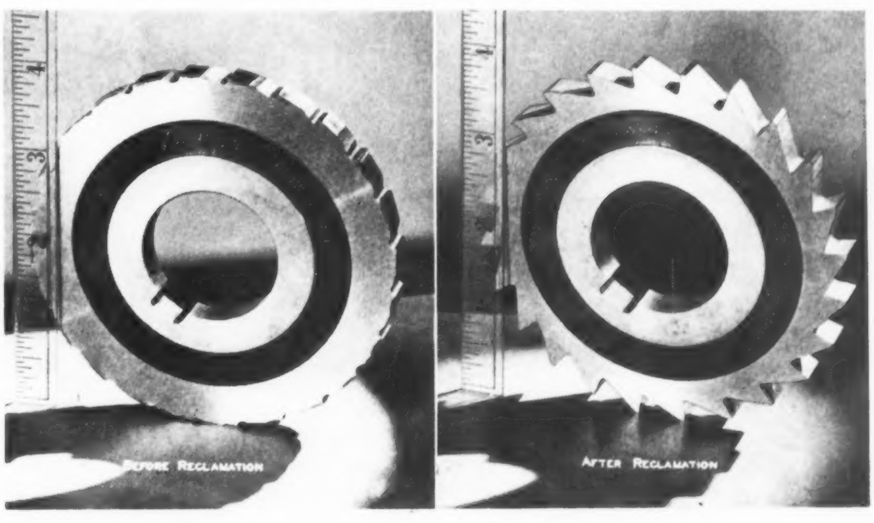
The land provides support to the cutting edge, and should be kept to a width of approximately 1/32 inch for small cutters and 1/16 inch for larger cutters, in order that the relief back of the cutting edge may be as small as possible. Resharpening increases the width of the land; when too wide, it is generally reduced by the grinding of a secondary clearance angle.

Clearance provides chip space in the flutes of the cutter. Proper clearances should be established, as too great clearance causes the cutting edges to wear more rapidly. On the other hand, insufficient clearance means that the tool will not cut freely. The clearance or chip room is generally governed by the number of teeth and the diameter of the cutter. Care should be taken in recutting tools to provide sufficient chip room in the flutes, and still not have the tooth too thin at the root; otherwise, a build-up of chips may exert unnecessary pressure on the tooth and result in breakage of the cutter.

Proper Finish Increases Cutter Life

Finish is of great importance, and proper grinding wheels must be used. If cutters are sharpened with grinding wheels that leave the edge rough or with "saw teeth," these high points or "teeth" break off when the cutter comes in contact with the work, and the edges become dull before long. The smooth finishes obtained by using the proper grinding wheel will often aid in producing two to three times as many parts as obtained from cutter teeth with a rough finish. Finer finishes at the cutting edges of the tool have been found to increase the cutter life sufficiently to make finish-grinding or lapping operations economical for many applications.

Cutting tools can be forced to remove metal after they have reached the point of dullness at which regrinding would be economical; but more power is consumed, and the motor and machine become overloaded. Obviously, the cutter life is reduced and production costs are increased. The output per man-hour or machine-hour is largely determined by the condition of the tools used.



Figs. 3 and 4. Plain Milling Cutter before and after the Reclaiming Process

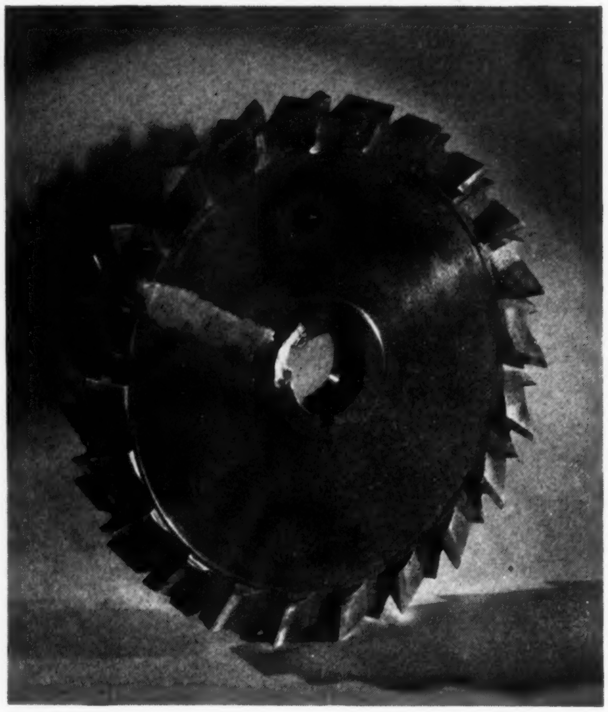


Fig. 5. Solid High-speed Steel Cutter, 1 Inch Wide, with Staggered Teeth, Reclaimed by Welding with Stainless-steel Rod. Cost of New Cutter, $100; Cost of Reclaiming, $25

Solid high-speed steel cutters offer particularly good salvage possibilities. For example, a worn standard side-milling cutter can be changed to an alternate-tooth or staggered side-milling cutter. Plain milling cutters can be converted to side-milling cutters, angle cutters, form cutters, etc. Solid reamers can be refluted and ground to smaller sizes. Shell reamers that have to be maintained at a certain size can be annealed, caulked, stress-relieved, hardened and ground. Drills can be resharpened and made into countersinks or counterbores. Inserted-tooth cutters can be reconditioned by inserting liners under the teeth and regrinding. Jig saw blades can be reset and sharpened. In general, most solid types of cutting tools can be salvaged, provided the cost of repairs does not make it uneconomical.

Drill life is greatly dependent upon the cutting edges of the drill being of the same angle (59 degrees for general purposes) and of the same length. Tests have shown that drill-grinding machines conserve the life of a drill, compared with hand grinding. The latter often leads to broken drills or ineffective cutting. Improper grinding will result in holes that will be larger than the drill size. Also, since the drill is forced against the side wall of the hole, excessive wear is caused at the "margin" of the drill.

Most cutter grinding is done dry; but when a large amount of stock has to be removed, a coolant should be used. Since most cutter grinding is done dry, it is necessary that the grinding wheel be of a soft grade to insure a free and cool cutting action, and that light cuts be taken. Probably more damage is done in sharpening tools than during any other phase of their use. Improper sharpening severely limits cutting feeds and speeds. Too great stock removal may result in only a fraction of a tool's capacity being used before it reaches the scrap pile.

Emphasis should not be placed on how many cutters an operator can regrind in a day, but on

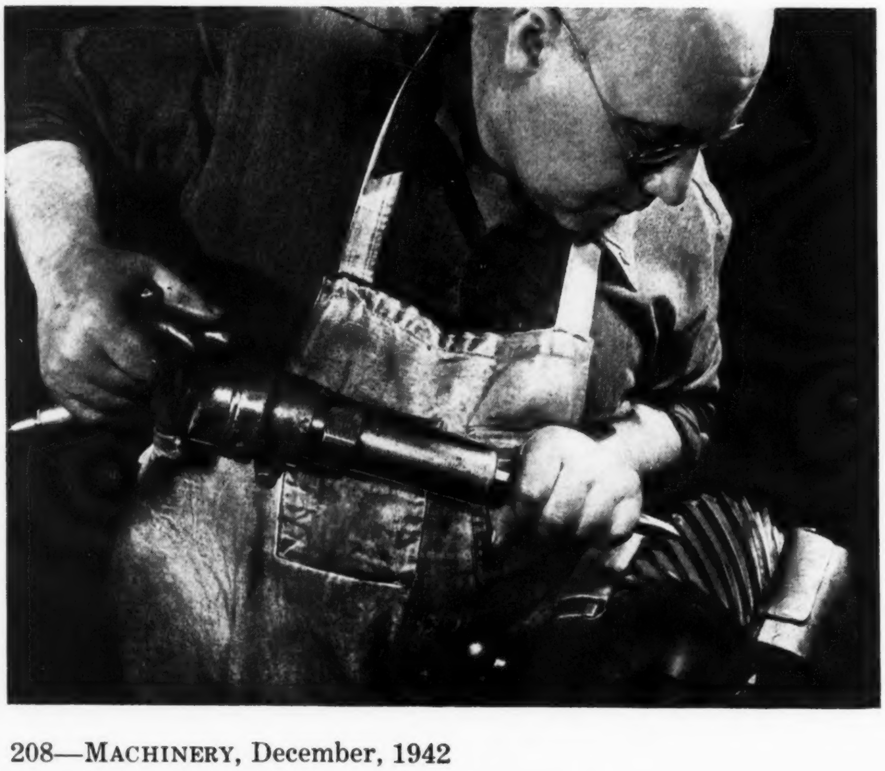


Fig. 6. Cutters, the Diameter of which Must be Maintained, are Annealed, Caulked, Stress-relieved, Hardened, and Ground. Illustration Shows Caulking Operation for "Lifting" the Teeth of the Cutter before Regrinding to the Original Size

Fig. 7. Cutting the Teeth in a 5-inch Plain Milling Cutter by Grinding New Clearance or Chip Room —This has been Found to Practically Double the Life of the Cutter

how many cutters he can sharpen properly—that is, with keen cutting edges, correct clearance angles, and with all teeth of uniform height. The number of parts produced per regrind and the number of regrinds in the life of the cutter are a measure of the quality of the sharpening operations.

The savings derived by reconditioning, compared with the initial cost of the cutting tool, are quite large. For example, a high-speed steel plain milling cutter, 4 1/2 inches in diameter by 6 inches long, with a 45-degree helix, costs approximately $86. The life of the cutter until it reaches the complete recutting stage is quite long. At the point of reconditioning, where it has to be completely recut, the cutter can be made practically new at a cost of approximately $18, effecting a saving of approximately $68. The cutter can go through this cycle several times until it reaches the stage where it cannot be reclaimed economically.

Recent experiments in the welding of cracked or broken cutters have also proved to be quite satisfactory. In one case, a 10-inch diameter, solid, high-speed steel, alternate-staggered-tooth keyway cutter, 1 inch wide, with a crack 0.005 inch wide extending from the keyway to the bottom of a cutting tooth, was repaired by the following method:

1. A groove was ground on both sides, at the end of the crack, to a depth of 1/8 inch, having a 1/8-inch radius at the bottom, with a 10-degree angle on each side of the groove.

2. The cutter was preheated to 800 degrees F.

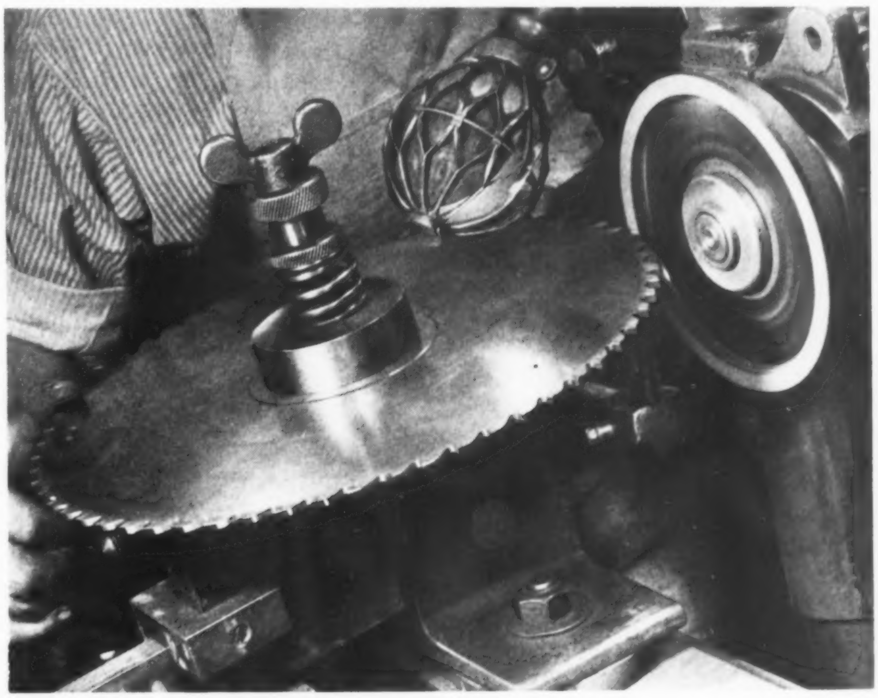


Fig. 8. Lapping a 5/32-inch Thick Tungsten-carbide-tipped Saw with 180-grit Diamond Lapping Wheel to Increase Cutting Efficiency and Cutter Life — Lapping of Cutting Edges of Both Carbide and Steel Tools has Proved its Value

3. It was welded with Westinghouse 18-8 stainless steel rod, 1/8 inch in diameter.
4. It was heated again to 800 degrees F. and cooled slowly in an open-end furnace.
5. The cutter was hardened by heating to 2300 degrees F., followed by cooling in an air blast.
6. Finally, the cutter was ground.

The cutter was placed in service on a heavy-duty cutting operation and has held up satisfactorily. The initial cost of a cutter of this type is approximately $100. The repair costs for the operations mentioned amounted to $25, providing a saving of approximately $75.

* * *

Locating Holes with Gage-Blocks and Microscope

By D. V. STEVENS

The writer read with a great deal of interest the article entitled "Locating Holes with Gage-Blocks and Indicator," which appeared in June MACHINERY, page 146. During the past year, a similar method of locating holes has been used by the Kearney & Trecker Corporation for performing precision boring operations on milling equipment when the jig borers were overloaded with work.

The accompanying illustration shows how a locating microscope, edge-block and gage-blocks are used to position the work for a boring operation requiring a precision set-up. The hole, in this case, must be located accurately in relation to the finished base and one machined edge of the casting. The correct dimension from the machined edge to the center line of the hole was obtained by placing a parallel against the edge of the work with one end extending a sufficient amount to back up a stack of gage-blocks of the proper thickness. The vertical dimension was obtained, as shown in the illustration, by stacking the correct gage-blocks directly on the machine table.

Locating Work for Precision Boring Operation by Means of Gage-blocks and Microscope

The edge-block consists of two pieces of hardened, ground, and lapped steel, joined to form an L-shaped piece. The line formed by the joint and accentuated by herringbone lapping marks, provides a locating point which can be brought into clear focus in the microscope.

The microscope shown in the illustration has a magnification power of 45 diameters, and uses double cross-lines which intersect to form a square that is used as a guide in locating a given point in line with the axis of the machine spindle. The shank of the microscope is mounted on pre-loaded ball bearings. Thus, when the instrument is in use, the machine spindle can be run at low speed, so that any running out of the spindle or adapter can be detected and compensated for at once. This equipment, including the locating microscope, which is made by the Center Scope Instrument Co., is also used on vertical milling machines for obtaining precise spacing of bored holes.

* * *

Scrap Campaign of the Automotive Industry

The directors of the Automotive Council for War Production have recommended to automobile manufacturers that they scrap all tools, dies, and fixtures for the manufacture of replacement parts where the demand indicates that this equipment is no longer necessary for the maintenance of essential automobile transportation. This is part of the national scrap drive inaugurated by the Industrial Salvage Section of the War Production Board. The Board requests that this scrap material be disposed of immediately, in order that it may become available to the steel industry just as soon as possible.

* * *

Gorton Machines Carry Victory Label

Machines shipped by the George Gorton Machine Co., Racine, Wis., carry, in a prominent place, a war production slogan on a red, white, and blue background. The top lines read "Here's Your New Gorton Precision Machine Tool," and then follow three lines in larger type: "Hi, Buddy, Let's Get to Work for America." The sign will be clearly visible from the moment the machine arrives and thereafter for the duration of the war to the workers that operate the machine or that pass by it at all hours of the day and night.

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Welding, Bending, and Flanging Wrought Iron

A. M. BYERS CO., Pittsburgh, Pa. Instruction books on the following subjects: Welding and flame-cutting of wrought iron; bending of wrought-iron plates; and bending and flanging of wrought-iron pipe. Also wall chart with ready reference instructions on oxy-acetylene and electric welding of wrought iron. 1

Abrasive Cloth Appliances

BEHR-MANNING CORPORATION, Troy, N. Y. Chart entitled "Metalite Cloth Gadgets Speed Sanding—Better Work in a Fraction of the Time," illustrating and describing numerous coated abrasive "gadgets" that have been developed for war needs and are doing much to speed production in almost every branch of industry. 2

Metal Cleaning

OAKITE PRODUCTS, INC., 26 Thames St., New York City. Publication entitled "A Digest of 41 Essential Maintenance Jobs Performed in Factories and Mills," showing how Oakite materials have been successfully used to speed up work, save man power, and get more service out of existing equipment. 3

Repairing Conveyor Belts

B. F. GOODRICH CO., Akron, Ohio. Booklet entitled, "Rubber Conservation for Users of Industrial Rubber Belting," describing, step by step, the procedure in making repairs on conveyor belts by the use of portable electric vulcanizers. Other suggestions for saving rubber are included. 4

Steel Handbook

UNION DRAWN STEEL DIVISION OF REPUBLIC STEEL CORPORATION, Massillon, Ohio. Steel Handbook No. 37, for machine tool users, comprising information designed to aid the steel user in selecting the right steel for the right purpose, and in securing the highest efficiency in his production processes. 5

Blow-Torch Chart

TURNER BRASS WORKS, Sycamore, Ill. Wall chart entitled "Know Your Blow-Torch," containing an illustration of a blow-torch, with individual parts designated, together with lighting instructions and safety hints, especially intended for schools engaged in war industries training. 6

Time-Saving Boring-Bar Holders

CLAYTON MFG. CO., Alhambra, Calif. Leaflet descriptive of the Clayton boring-bar holders which incorporate a dual clamping arrangement that permits the holder to be removed from the lathe without disturbing the alignment of the boring-bar. 7

Wire- and Cable-Insulating Plastics

HALOWAX PRODUCTS DIVISION, UNION CARBIDE AND CARBON CORPORATION, 30 E. 42nd St., New York City. Booklet on Vinylite plastics for wire and cable insulation, now being used for most of the purposes previously served by rubber. 8

Lighting Equipment

FOSTORIA PRESSED STEEL CORPORATION, Fostoria, Ohio. Catalogue 1042, illustrating and describing how good lighting and the near infra-red process are speeding the production of war materials on the land, on the sea, and in the air. 9

Micarta Products

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. Booklet B-3184, containing information intended to provide manufacturers of war equipment with design and selection data on the application of Micarta—an all-purpose industrial plastic. 10

Stellite Metal-Cutting Tools

HAYNES STELLITE CO., Kokomo, Ind. Circular 5783, entitled "Stellite 98M2 Metal-Cutting Tools for Machining Steel," listing the sizes and prices of eighty-four standard square and rectangular Stellite 98M2 tool bits and seventy-four welded-tip tools. 11

Arbor and Foot Presses

FAMCO MACHINE CO., Racine, Wis. Folder covering the line of arbor and foot presses made by this company. Data Sheet No. 7-B, giving dimensions, load capacities, and floor-space requirements of over forty stock models of Famco arbor presses. 12

Copper and Copper Alloys

REVERE COPPER & BRASS, INC., 230 Park Ave., New York City. Comprehensive handbook on copper and copper alloys, including information on the properties, welding technique, specifications, manufactured forms, pipe and tube dimensions, weights, etc. 13

War Production Facilities

L. O. KOVEN & BROTHER, INC., 154 Ogden Ave., Jersey City, N. J.

Catalogue entitled "Koven Men and Machines for War Work," showing the facilities and equipment available at this company's plants for the production of war equipment. 14

Carbide Tools

McKenna Metals Co., 147 Lloyd Ave., Latrobe, Pa. Catalogue 43, listing standard, "non-standard," and "special" carbide tool tips, and giving specific information on the successful application of Kennametal tools. 15

"Trouble-Shooting" Grinding Manual

Norton Co., Worcester, Mass. Manual entitled "What's Your Grinding Problem?" describing various problems encountered by grinding machine operators, and their solutions. 16

Duronze Manual

Bridgeport Brass Co., Bridgeport, Conn. Duronze Manual, giving compositions and specifications, as well as curves showing cold-drawing and annealing characteristics of five different Duronze corrosion-resisting alloys. 17

Threading Wrought-Iron Pipe

A. M. Byers Co., Pittsburgh, Pa. Bulletin giving complete instructions on the threading of wrought-iron pipe. Also wall chart entitled "Trouble-Shooter for Correcting Threading Ills—Do's and Don'ts in Threading." 18

Weekly Calendar for Drafting-Rooms

Frederick Post Co., Box 803, Chicago, Ill. 1943 weekly calendar, about 16 by 25 inches, especially intended for drafting-rooms and containing charts on wire and sheet-metal gages, screw threads, etc. 19

Low-Temperature Welding Alloy

Eutectic Welding Alloys Co., 40 Worth St., New York City. Circular describing the characteristics and applications of a special Castolin eutectic alloy for the low-temperature welding of cast iron. 20

Malleable Iron

Lake City Malleable Co., Cleveland, Ohio. Booklet entitled "Fighting Men—Critical Materials, Both Aided by 'Shock-proof' Malleable Castings," illustrating a number of conversions from various critical materials to malleable iron. 21

Induction Heat-Treating

Ohio Crankshaft Co., 3800 Harvard Ave., Cleveland, Ohio. Booklet entitled "Faster Production with Tocco," describing typical applications of the Tocco process of induction heat-treating. 22

Cylindrical Grinders

Farrel-Birmingham Co., Inc., Ansonia, Conn. Bulletin 113, describing the design, construction, and operating advantages of the Farrel Type TT roll grinder with traveling work-table. 23

Abrasive Cutting

Andrew C. Campbell Division, American Chain & Cable Co., Inc., Bridgeport, Conn. 32-page book entitled "Abrasive Cutting," explaining the development and application of this process. 24

Cutting Tool Equipment

Industrial Engineering Co., Inc., 141 W. Jackson Blvd., Chicago, Ill. Folder on cushioned cutter pilots for deep-hole boring up to 10 inches in diameter with carbide-tipped tools. 25

Engraving and Etching Equipment

George Gorton Machine Co., 1316 Racine St., Racine, Wis. Catalogue 1635-A, on munitions engraving machines and Spit-Fire electric-arc etchers. 26

Motor Drives

American Pulley Co., 4200 Wissahickon Ave., Philadelphia, Pa. Catalogue ED-42, illustrating and describing the new American "Econ-O-Matic" drives, with either V-belt or flat belt. 27

Reclamation of High-Speed Steel Tools

Welding Equipment & Supply Co., 223 Leib St., Detroit, Mich. Catalogue entitled "Reclamation by Welding of High-Speed Steel Tools." 28

Holding Fixtures

Zagar Tool, Inc., 23880 Lakeland Blvd., Cleveland, Ohio. Bulletin illustrating and describing the Zagar collet chucking fixture, a universal device for indexing or holding work on machine tools. 29

Precision Grinders

Dumore Company, 14th and Racine Sts., Racine, Wis. Catalogue 42, containing 36 pages on Dumore portable precision grinders and their applications, designed to facilitate their selection. 30

Hollow-Mills and Special Production Tools

Genesee Mfg. Co., Inc., Rochester, N. Y. Catalogue 42, covering Genesee adjustable hollow-mills, facing and counterboring tools, and special production tools. 31

Broaches

Colonial Broach Co., Box 37, Harper Station, Detroit, Mich. 24-page booklet containing two sections—"Answers on Broaching" and "Broach Sharpening Recommendations." 32

Motor-Finder Slide-Rule

Allis-Chalmers Mfg. Co., Milwaukee, Wis. Slide-rule designed to help the motor user quickly select the correct type of squirrel-cage motor for various conditions of service. 33

Bronze Alloys

Ampco Metal, Inc., 1745 S. 38th St., Milwaukee, Wis. Booklet entitled "Contribution to Victory," calling attention to the use of Ampco metal bronzes in the war industries. 34

Automatic Milling Machines

Cincinnati Milling Machine Co., Cincinnati, Ohio. Publication illustrating, describing, and giving specifications of the Cincinnati No. 0-8 plain automatic milling machine. 35

Slotmasters

Experimental Tool & Die Co., 12605 Greiner Ave., Detroit, Mich. Catalogue describing the universal Slotmaster, and showing six different set-ups for various types of work. 36

Flexible-Shaft Machines

Foredom Electric Co., 27 Park Place, New York City. Catalogue 30, showing typical examples of the wide range of uses of Foredom flexible-shaft machines. 37

Belting

Multiple V-Belt Drive Association, 140 S. Dearborn St., Chicago,

Ill. Booklet entitled "Twenty-three Ways to Conserve the Life of Multiple V-Belt Drives." 38

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THOMSON-GIBB ELECTRIC WELDING CO., Lynn, Mass. Booklet entitled "Flashes from the Production Front," illustrating applications of electric resistance welding machines. 39

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BROWN INSTRUMENT CO., Wayne and Roberts Aves., Philadelphia, Pa. 64-page publication 80-1, entitled "The Technique of Precision Control in Industrial Processes." 42

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JESSOP STEEL CO., Washington, Pa. Circular listing the outstanding characteristics and applications of Jessop "Truform" oil-hardening, non-shrinkable steel. 44

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OZALID PRODUCTS DIVISION, Johnson City, N. Y. Catalogue entitled "Simplified Printmaking," relating to duplication of tracings and transparent prints. 45

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D. O. JAMES MFG. CO., 1120 W. Monroe St., Chicago, Ill. Circular illustrating typical examples of this company's line of gears and gear reducers. 47

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ALLEN-BRADLEY CO., 1331 S. First St., Milwaukee, Wis. Bulletin describing the Allen-Bradley line of Bulletin 836 pressure and temperature controls. 48

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ALLIS-CHALMERS MFG. CO., Milwaukee, Wis. Booklet entitled "Plain Facts on Wartime Care of Rubber V-Belts." 49

Gear-Finishing Machines

MICHIGAN TOOL CO., 7171 E. McNichols Road, Detroit, Mich. Bulletin 861-42, describing a light-duty gear-finishing machine for gears less than 4 inches in diameter. 50

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FRAY MACHINE TOOL CO., Glendale, Calif. Catalogue illustrating and describing the No. 7-B ram type, vertical, universal milling machines made by this company. 51

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REEVES PULLEY CO., Columbus, Ind. Folder entitled "Reeves Variable-Speed Control on 210,000 Production Machines throughout America." 53

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AMERICAN PULLEY CO., Philadelphia, Pa. Catalogue R-42, on speed reduction drives for driven speeds of from 11 to 154 R.P.M., and from 1/2 to 25 H.P. 54

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AMPCO METAL, INC., 1745 S. 38th St., Milwaukee, Wis. Engineering Data Sheet No. 105, "Experience Essential in Bronze Alloying." 57

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MCKENNA METALS CO., 147 Lloyd Ave., Latrobe, Pa. Bulletin 442, on "Chip-Breaker Designs." 60

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HILLIARD CORPORATION, Elmira, N. Y. Folder on friction clutches and friction cut-off couplings. 61

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DETROIT REX PRODUCTS CO., 13005 Hillview Ave., Detroit, Mich. Catalogue on Detrex degreasers. 62

Conserving Man-Power through Accident Prevention

The National Safety Council points out that last year 85,000 people were killed by accidents in the United States and 7,700,000 were injured. Of those killed, 42,000 were engaged in useful occupations. Industrial accidents accounted for but a small percentage of the fatalities, automobile accidents taking the most serious toll.

Because of these alarming figures, a nation-wide effort is being made toward a concerted and intensified campaign against accidents of all kinds. Representative leaders of business and industry, to further this effort, have organized the War Production Fund to Conserve Man-Power and have contributed the money required to carry on the work involved in reducing accidents. The National Safety Council is back of the War Production Fund, which latter has headquarters at 71 Broadway, New York City.

The National Safety Council has worked out a careful plan to promote this work. No radical departures from the Council's previous practice are contemplated. Existing safety organizations will be enlisted in this work; more technical assistance will be made available; and more public cooperation will be sought.

Information on Available Tool- and Gage-Making Facilities

The Automotive Council for War Production, New Center Bldg., Detroit, Mich., is maintaining a Tooling Information Service which provides valuable assistance to manufacturers in the war emergency. Each week 1500 users of gages receive reports which show the names and addresses of shops capable of handling additional gage and tool work. Nearly 400 shops, including about 175 gage manufacturers, supply information on their available capacity each week.

Besides showing the available capacity of tool and gage makers, the report lists services available for repairing and salvaging all types of tools and gages. An interesting feature of the report is that it gives "precision ratings" of tool and die manufacturers in terms of plus or minus limits of 0.001, 0.0005, and 0.0001 inch. The report also indicates the average delivery periods of different companies, as, 3 to 6 weeks; 6 to 8 weeks; 8 to 10 weeks; and over 10 weeks.

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 215-226 is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment, fill in below the identifying number found at the end of each description—or write directly to the manufacturer, mentioning machine as described in December, 1942, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on other side of this blank.

To Obtain Additional Information on Materials of Industry

To obtain additional information about any of the materials described on pages 204-205, fill in below the identifying number found at the end of each description—or write directly to the manufacturer, mentioning name of material as described in December, 1942, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on other side of this blank.

Detach and mail to MACHINERY, 148 Lafayette St., New York, N. Y.

[SEE OTHER SIDE]

Shop Equipment News

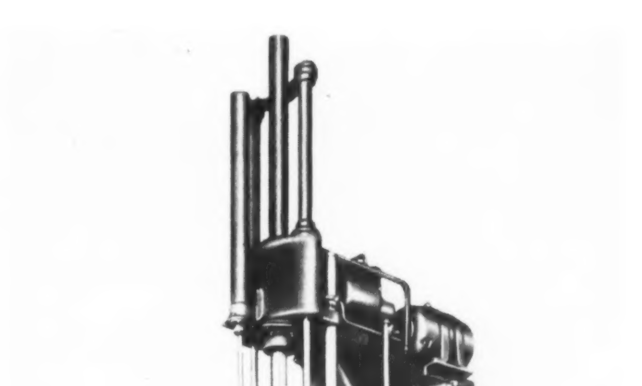
Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Giant Size "Barnesdril" Honing Machine

The Barnes Drill Co., 814 Chestnut St., Rockford, Ill., has just placed on the market a vertical honing machine of giant size, designated the "Barnesdril No. 4014." This self-oiling hydraulic honing machine with quick-change speed will swing work 40 inches in diameter, and has a capacity for finishing bores up to 14 inches in diameter. It is available in three standard spindle-travel lengths of 35, 50, and 65 inches. Three different styles can also be supplied. One style has a standard work-table; another, shown in the illustration, has a hydraulically controlled table with in-and-out movement; and the third style is supplied with a special fixture designed to suit the work to be handled.

With this machine, large-diameter cylinders, if reamed to within 0.005 to 0.008 inch of size can be accurately honed within 0.001 inch. The long honing stones used will pass over port holes and recesses in cylinders, leaving a true edge about these openings. Steel cylinders such as those used in hydraulic equipment should be smoothly bored or reamed within 0.0015 or 0.002 inch of the size required before final honing. Thus, various engine cylinders, sleeves, reciprocating parts, and a wide variety of cylindrical bores can be honed to exceptionally close limits and with a fine finish on this machine.

Auxiliary head applications with yoke connections to the spindle permit multiple heads to be attached when desired. The auxiliary heads may have two, three, or four spindles. Six quick-change spindle speeds are available. The machine is fully equipped with radial ball bearings and Timken roller bearings, including the spindle, which rotates in Timken bearings. These bearings are all self-oiling.



Hydraulic Honing Machine with Swing Capacity of 40 Inches, Built by the Barnes Drill Co.

Push-button controls are used for starting, "inching," withdrawing, and stopping the reciprocating cycle of the spindle. The patented rotary control can be set to provide for any desired number of spindle strokes. The speed of the reciprocating cycles can be changed to suit the work by means of the volume regulator control at the side of the machine column.

Mineral seal oil, kerosene, or other coolant in a generous flow from the coolant pump can be used to flood the hone while the machine is in operation. The coolant passes through special settling and filtering tanks before being recirculated to the hone. Jigs, splash guards, hones, and hone guides are supplied on order. Two motors are used—one for the hydraulic system and the other for the spindle drive, both of which are direct-connected.

The No. 4014 machine with 35-inch vertical spindle stroke is 171 1/4 inches in height. The maximum distance from the spindle to the table is 71 3/8 inches when equipped with a mechanical honing tool, and 64 3/4 inches when furnished with a hydraulic honing tool. The plain table with duplex raising screws has a finished surface of 22 by 44 inches. The table with in-and-out travel

To obtain additional information on equipment described on this page, see lower part of page 214.

has a finished surface of 30 by 30 inches. The vertical travel of the plain raising screw type table is 17 inches. The standard machines require a floor space of 76 1/2 by 60 inches. The weight of this machine is 11,500 pounds. The No. 4014A machine, with a 50-inch stroke, has a height of 216 1/4 inches and weighs 16,000 pounds. The No. 4014B machine, with a 65-inch stroke, has a height of 261 1/4 inches and weighs approximately 19,000 pounds. 71

Huge Drawing Press of Seven-Million Pounds Capacity

Completion of one of the world's largest self-contained deep metal-drawing presses has just been announced by the Hydraulic Press Mfg. Co., Mount Gilead, Ohio. This H-P-M Fastraverse press embodies two hydraulically actuated units. One unit comprises a 3500-ton downward-acting die platen, and the other consists of a 1000-ton hydraulic die cushion that is located in the press bed.

The press frame consists of a cast-steel head and bed, spaced by a pair of cast uprights. Two pre-loaded tie-rods or strain rods pass through each upright and lock the assembly together as one solid unit. The hydraulic cylinder, with the power ram which actuates the main slide, is incorporated in the head. The slide is guided by beveled ways on the four inner corners of the uprights through adjustable gibs, so positioned as to oppose any twisting of the slide.

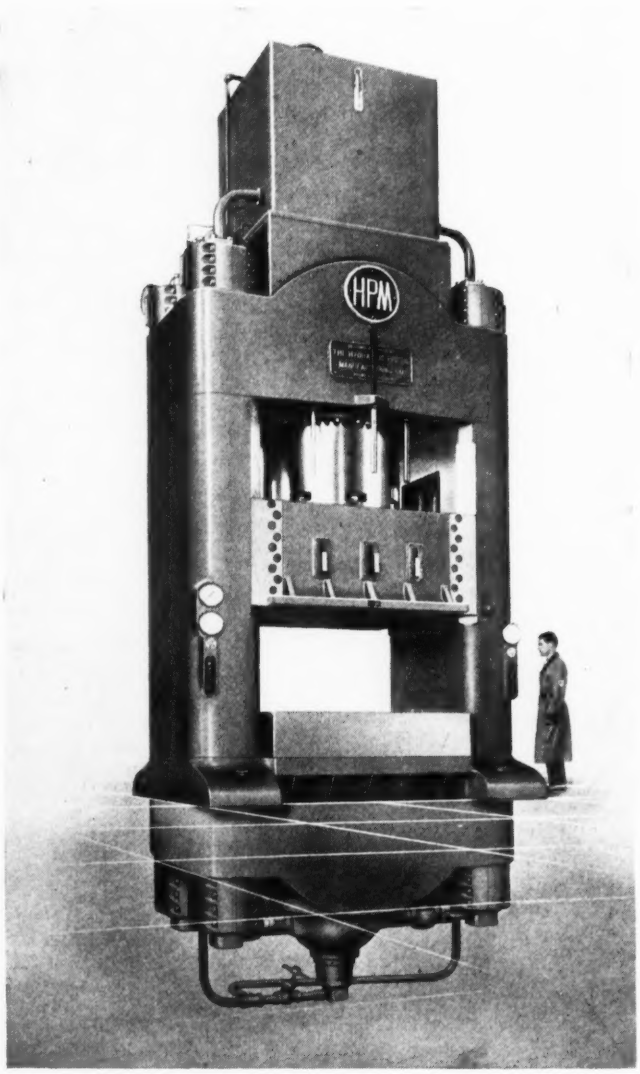
This press is capable of deep-drawing heavy steel plate to a depth of 18 inches. More than one drawing operation may be necessary, however, depending upon the thickness of the metal and the reduction required. The press can be operated effectively at full pressure capacity for any length of stroke within its range. With the die cushion idle, it can be used for single-action pressing operations, such as coining, sizing, straightening, etc.

Only one hydraulic pump is required to operate the press. Pressure exerted by oil trapped in the die-cushion cylinder is intensified by the downward movement of the main press slide. This intensified pressure produces the resisting force necessary for holding the blank. No compressed air or other outside pressure source is required to operate the die cushion.

The compound press ram permits the use of two main slide pressure ranges—first, a minimum pressure range up to 1000 tons; and second, a high-pressure range from 1000 up to 3500 tons. These two pressure ranges can be applied in sequence through the press cycle or independently, as desired. The compound ram system is especially useful when a large portion of the pressing stroke can be accomplished with medium pressure and when high pressure is required only for the final forming. If the work permits, only medium pressure need be employed for the complete pressing stroke. This allows a faster pressing speed than if both the minimum and high pressure ranges were used.

The closed-circuit operating system provides for complete and accurate control of all press-ram movements without an operating valve. Reversal of the ram is smooth and shockless. Means are provided for operating the press either manually, semi-automatically, or automatically. Electric push-button controls are provided.

The pressing surface of the main slide is 84 by 96 inches, and, of the die cushion, 65 by 65 inches. The daylight space between the slide and bolster is 72 inches; the maximum ram travel, 36 inches; and the maximum shut height, 36 inches. The closing speed of the ram is 355 inches per minute; the pressing speed at a pressure of 1000 tons, is 53 inches per minute, and at 3500 tons, 15 inches per minute. The weight of the machine is 521,600 pounds. 72

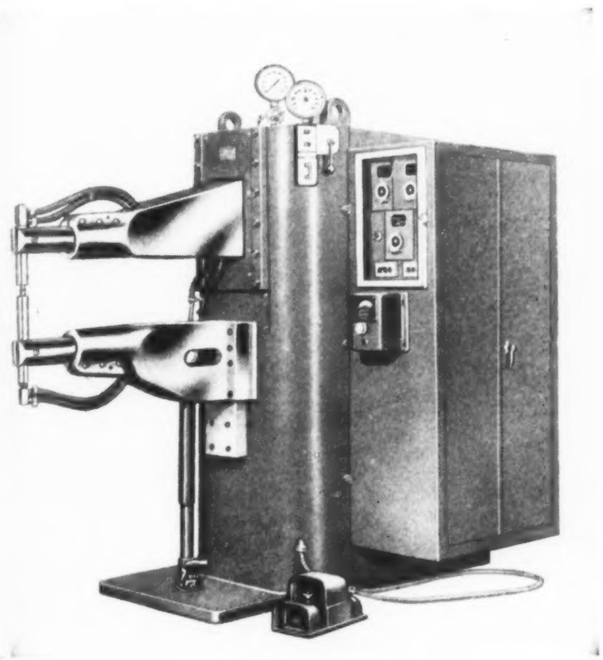


H-P-M Fastraverse Press Built for Drawing Heavy Steel Plate to a Depth of 18 Inches

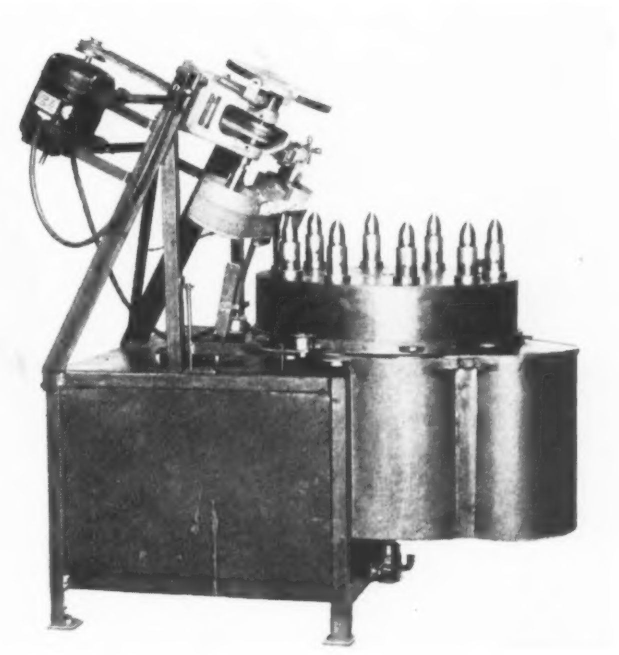
New Cutting Oils

A new line of cutting oils has been brought out by the Standard Oil Co. of Indiana, 910 S. Michigan Ave., Chicago, Ill. These new cutting oils have been developed to meet the present-day requirements of faster speeds, and new methods of tooling, closer tolerances, and higher finishes, as well as the increased use of the new alloy steels that are not so easily machined as the metals formerly used. 73

To obtain additional information on equipment described on this page, see lower part of page 214.



Rocker-arm Resistance Welder Made by Sciaky Bros.



Shot-tip Polishing Machine Built by Leiman Bros., Inc.

Sciaky Rocker-Arm Resistance Welder

A rocker-arm resistance welder—Type PMCR.2S16—designed primarily for spot-welding aluminum and its alloys, has just been brought out by Sciaky Bros., 4915 W. 67th St., Chicago, Ill. This machine embodies all the features found in the regular line of Sciaky welders, such as stored energy with preheating, and variable pressure with recompression. It also has several unique advantages, including adjustable electrode tips, which can be set at any angle without impairing their action. Such settings make possible the welding of metal parts of unusual shapes and sizes that could not be welded with ordinary welding machines. All gages and dials are visible to the operator and are set on the frame of the machine. This makes possible greater flexibility in operation when using a large range of shapes and designs.

In use, the rocker-arm welder compensates for the natural expansion that takes place when the metal is in the molten state during the welding process. With this welder, the metal is preheated to overcome high thermal conductivity, thus slowing down the cooling process and providing the added protection of a "forging pressure" which, in itself, precludes the possibility of shrinking the metal after welding.

This rocker-arm machine supplies a total pressure of 3000 pounds between the electrode tips when operated by an air supply line of 90 pounds per square inch pressure and when using a normal throat depth of 34 inches. It has a capacity for welding two 0.080-inch 24ST Alclad sheets. The welding stroke is 1/2 inch, and the retraction stroke 3 1/2 inches. A special 45-degree faceplate can be incorporated with the vertical faceplate. 74

Shot-Tip Polishing Machine

An automatic abrasive-belt polishing machine designed to polish 37-millimeter shot tips and similar work, preparatory to tinning, at the rate of 1000 per hour has been brought out by Leiman Brothers, Inc., PA 146 Christie St., Newark, N. J. This machine is so arranged that a number of rotating chucks, mounted on a rotating table, hold the parts to be polished while they are carried past the abrasive belt. When the table brings a chuck to the loading point, the rotation of the chuck is stopped automatically just long enough to permit replacing the polished shot with an unpolished one. The rotating table is indexed intermittently to bring the work against the abrasive belt, so as to permit each piece to remain in contact with the belt for a short period while it is being polished. The abrasive belt is driven by a separate motor, and can be operated at any one of three speeds.

Two small motors are employed, one for driving the chucks and one for driving the wheel. The driving mechanism is enclosed in a dust-tight base. The abrasive belts are inexpensive, and can be quickly replaced. This machine occupies a floor space of about 38 by 45 inches, and is 52 inches high. 75

Sturtevant Torque-Measuring Wrenches

A line of torque-measuring wrenches comprising eight models ranging in size and capacity from small instrument wrenches of a few inch-pounds capacity to large two-handled torque wrenches of 7200 inch-pounds capacity has been brought out by the P. A. Sturtevant Co., Addison, Ill. These wrenches are being widely used for measuring torsional force, as when equalizing the "set" of screws or nuts by tightening to a predetermined torque, or for measuring the frictional drag in motors or mechanisms. They are suitable for use in both manufacturing and inspection departments. All are of the flat tapered beam type with fixed end and top scales. 76

To obtain additional information on equipment described on this page, see lower part of page 214.

Covel Universal Cutter and Tool Grinder

Flexibility, speed, and adaptability for a wide range of operations are outstanding features of the No. 22 universal cutter and tool grinder recently developed by the Covel Mfg. Co., Benton Harbor, Mich. This machine has a heavy box type bed. All controls can be manipulated from the front or rear of the machine. Sensitive control is obtained by mounting the table and saddle on ball bearings A locking device is provided for holding the spindle when changing grinding wheels.

The spindle has spring-loaded, large size, cartridge type ball bearings. Table, saddle, and vertical adjustment slides can be locked securely after setting. Any one of three wheel speeds can be quickly obtained through the V-belt drive. The grinding wheel motor is enclosed in the base, and all wearing surfaces of the machine have complete dust protection, the vertical column having telescoping metal guards.

By revolving the upper table 180 degrees, the maximum distance from the table to the spindle is increased 3 inches, thus increasing the cross-feed capacity. Hand rapid cross-travel to the saddle can be provided, and a swing type adjustable micrometer stop for limiting the forward travel of the saddle to facilitate inspection and accurate in-feeding can be furnished. When furnished with power feed to the table, a reversing motor is used.

A great variety of attachments are available for this machine. A wet-grinding attachment with splash guards, hoods, piping, and tank can be furnished.

The table has a longitudinal travel of 24 inches, and the grinding-wheel spindle has a vertical movement of 7 1/2 inches. The saddle has a cross movement of 8 inches. Work 10 3/8 inches in diameter and up to 30 inches in length can be swung between the right- and left-hand tailstocks. Work 24 inches in length can be handled by the three-speed headstock and right-hand tailstock. The face-mill capacity, with the universal face mill over the table, is 10 inches in diameter, and with the face mill over the sub-table, 18 inches. With the standard universal attachment over the table, the face-mill capacity is 16 inches in diameter, and over the sub-table 24 inches. The spindle takes grinding wheels having a maximum diameter of 8 inches and a 1/2-inch face with a 1 1/4-inch hole. The machine occupies a floor space of 57 by 89 inches, and the weight is approximately 2900 pounds. 77

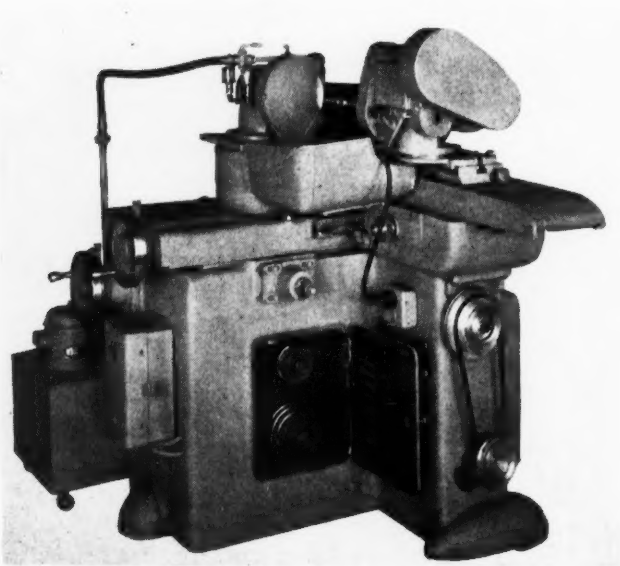
Wells Large-Size Band Saw

The Wells Mfg. Corporation, Three Rivers, Mich., has recently brought out a Model V-12 metal-cutting band saw, which has a capacity for cutting off rectangular metal bars 13 by 16 inches and round bars up to 13 inches in diameter. The general features of the Wells Nos. 5 and 8 machines are incorporated in this band saw, which also has a new hydraulically controlled feed and lifting apparatus, as well as several other recently developed features. Included in the equipment are a hand-operated, quick-acting vise; belt and gear drive; and ball-bearing support for moving parts.

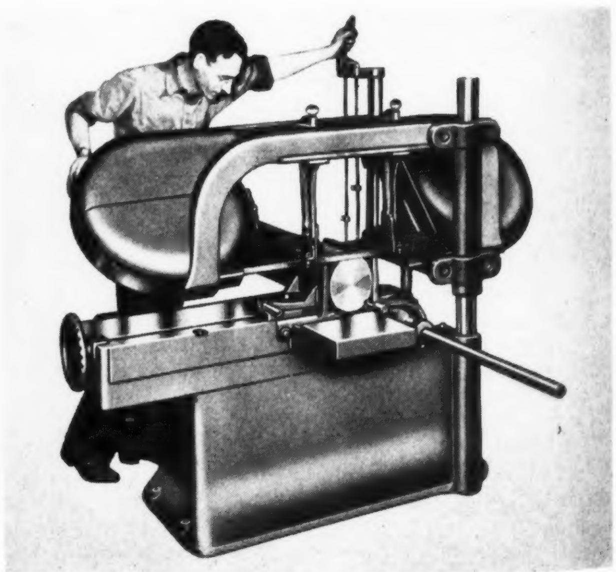
The most radical departure from the Nos. 5 and 8 sizes is in the appearance, the frame having been completely redesigned to provide the ruggedness necessary in the larger-size machine. The V-12 saw is equipped with a 3/4-H.P. electric motor which drives the blade at speeds of 53, 94, or 148 feet per minute, as required. This choice of speeds makes possible the cutting of almost any metal to practically any desired shape. The machine has a height of 52 1/2 inches, requires a floor space of 73 by 30 inches, and weighs 1750 pounds. 78

Felker Abrasive Cut-Off Blade

The Felker Mfg. Co., Torrance, Calif., is placing on the market a new diamond abrasive cut-off blade, designated "Di-Met Rimlock." This blade is claimed to be particularly



Universal Cutter and Tool Grinder Developed by the Covel Mfg. Co.

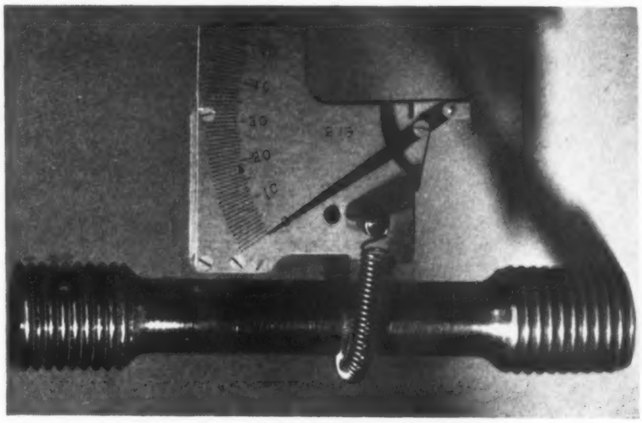


Band Saw Designed for Heavy Work by the Wells Mfg. Corporation

To obtain additional information on equipment described on this page, see lower part of page 214.

efficient in cutting all hard, brittle, non-metallic materials, such as quartz, glass, porcelain, tile, ceramics, etc. The Rimlock differs from former diamond abrasive blades in the special bonding process employed, which rigidly locks the diamonds in the rim of the wheel without crushing, a feature that is said to give longer life and a considerably faster cutting action.

This blade is available in two types — a hard steel bond type that is an exceptionally stiff and fast-cutting blade; and a copper bond type, which, although not quite so fast as the other type, operates with a softer cutting action and with a somewhat longer life. 79



Porter-Lipp Strain Gage

Porter-Lipp Strain Gage for Testing Structural Material

The American-made Porter-Lipp strain gage here illustrated is introduced on the market by the Baldwin Southwark Division of the Baldwin Locomotive Works, Philadelphia, Pa. This gage is designed for the rapid volume testing of structural materials. It is of a mechanical type—accurate, light, compact, rugged, and convenient to apply. The strain multiplication factor is approximately 300, and it has a range of 0.008 inch. It weighs only 4 ounces, and measures 1 3/4 by 2 inches by 5/8 inch. Each graduation corresponds to a strain of approximately 0.0001 inch, and has a readable accuracy of 0.00002 inch for a gaging length of 1 inch. 80

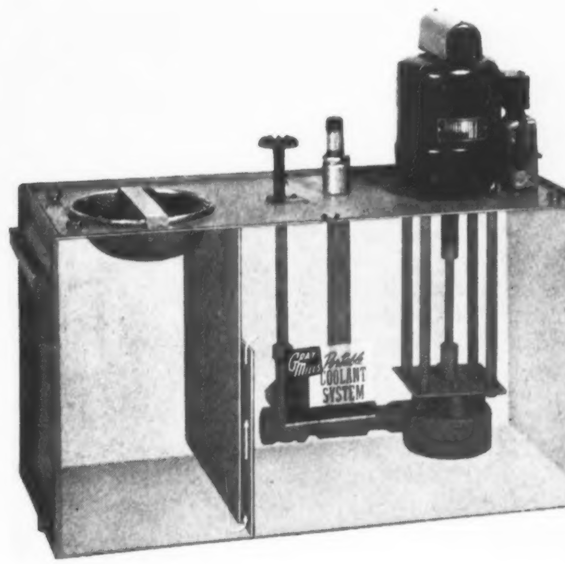
L&R Heavy-Duty Precision Cleaning Machine

A heavy-duty precision cleaning machine designed for cleaning instruments, meters, gages, bearings, small motor assemblies, jewels, jewel bearings, clocks, watches, gears, and an infinite variety of other small precision parts, many of which are too fragile to be cleaned by hand, has just been brought out by the L & R Mfg. Co., 54 Clinton St., Newark, N. J. This cleaner is similar in operation and design to the smaller precision cleaning machines of this company's manufacture, which have previously been described in MACHINERY. It is a portable unit weighing less than 50 pounds. The work-basket, when loaded, weighs only a few pounds, making speedy production possible without taxing the endurance of the operator. As many additional sets of baskets can be provided as are needed to keep each group of parts separated during the cleaning operation. 81

Gray-Mills Portable Coolant System

A portable coolant system using a centrifugal pump designed to deliver controlled coolant flow at the rate of from 10 to 1000 gallons per hour has been brought out by the Gray-Mills Co., 213 W. Ontario St., Chicago, Ill. This new system, designated G-10A, supplements two portable coolant systems previously placed on the market by this company. The new unit is particularly applicable to multiple-spindle and deep-drilling work, drill press installations, large cutting-off machines, grinders, milling machines, and turret lathes. 82

Precision Cleaning Machine for Small Parts, Brought out by L & R Mfg. Co.



Portable Coolant System Brought out by the Gray-Mills Co.

To obtain additional information on equipment described on this page, see lower part of page 214.

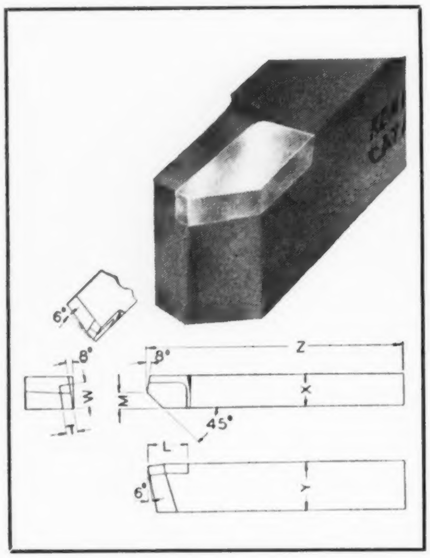


Fig. 1. Steel-cutting Kennametal Tool with Long Tip

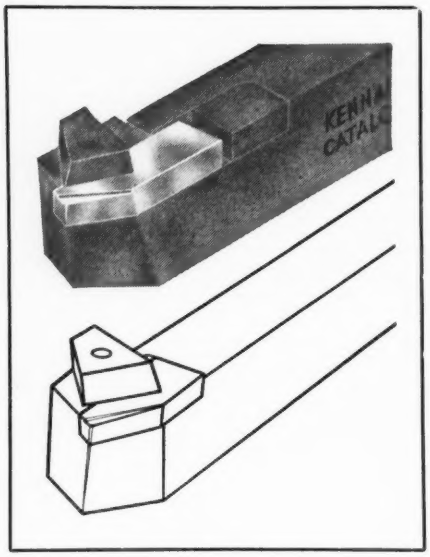


Fig. 2. McKenna Clamped-on Type Carbide-tipped Tool

Carbide Tools for Cutting Steel

To meet the demand for a steel-cutting carbide tool having a lead angle, the McKenna Metals Co., 147 Lloyd Ave., Latrobe, Pa., has brought out Styles 39 and 40 Kennametal tools. These tools combine the lead angle or side cutting edge angle with a longer tip than is customarily provided on carbide tools having a lead angle. Style 39, as shown in Fig. 1, and tools of the opposite hand designated Style 40 have now been added to the regular Kennametal line.

These tools are particularly adapted for shell-turning operations, since only the edge on the lead angle is sharpened and it is easy to maintain the control position of the nose as the tool is reground. They can be used for chamfering and for machining uniform forgings where the depth of cut never exceeds the length of the tip with a lead angle. The chip-breaker is ground only on the section parallel to the lead angle. The tools are available in sizes of 1/8 by 5/16 by 5/8 inch up to 3/8 by 3/4 inch by 1 1/2 inches.

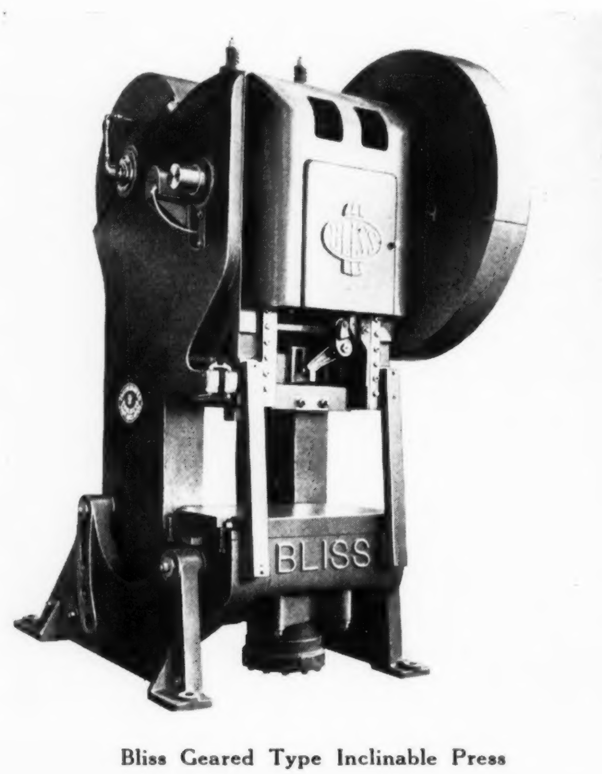
Another new steel-cutting tool added to the Kennametal line is the clamped-on carbide-tipped type shown in Fig. 2. This differs from the previous type of clamped-on tool in that the clamp is secured by a screw inserted from the bottom of the shank and extending to the top of the clamp. This feature eliminates the need for a mechanical device at the top of the clamp which might interfere with the use of the tool. A flat surface is milled on the tool shank to accommodate the cutting tip. These tools are made in both right- and left-hand types, designated as Styles 51 and 52.

In cases where a chip-breaker is required, it is ground directly in the tip and not in the clamp. After regrinding, the tip is moved forward under the clamp, shims being placed behind the tip, when the tip becomes too small for service in the regular tool-holder, it can be brazed into a small shank for light turning or boring operations. The clamped-on tip permits using a heat-treated shank. Better results are obtained in sharpening when the tip is lightly applied to the grinding wheel to avoid overheating. These tools are available in three square sizes of 1, 1 1/4, and 1 1/2 inches, and in two flat sizes of 1 by 1 1/2 and 1 1/2 by 2 inches. 83

Bliss 150-Ton Inclinable Press

The E. W. Bliss Co., Second Ave. and 53rd St., Brooklyn, N. Y., has just placed on the market a Bliss-Consolidated No. 9 inclinable press equipped with a Marquette pneumatic cushion. The press is of the geared type, with the main working parts either enclosed within the housing or in guards designed to protect the operator. Heavy removable tie-bars are used in front of the frame to eliminate deflection.

The press can be inclined 39 degrees to allow the completed work to fall to the rear of the machine. It has an open-back, gap type frame which permits strip stock to be fed either from right to left or from front to back. The new type lever- and cam-operated knock-out slide has a single adjustment. 84

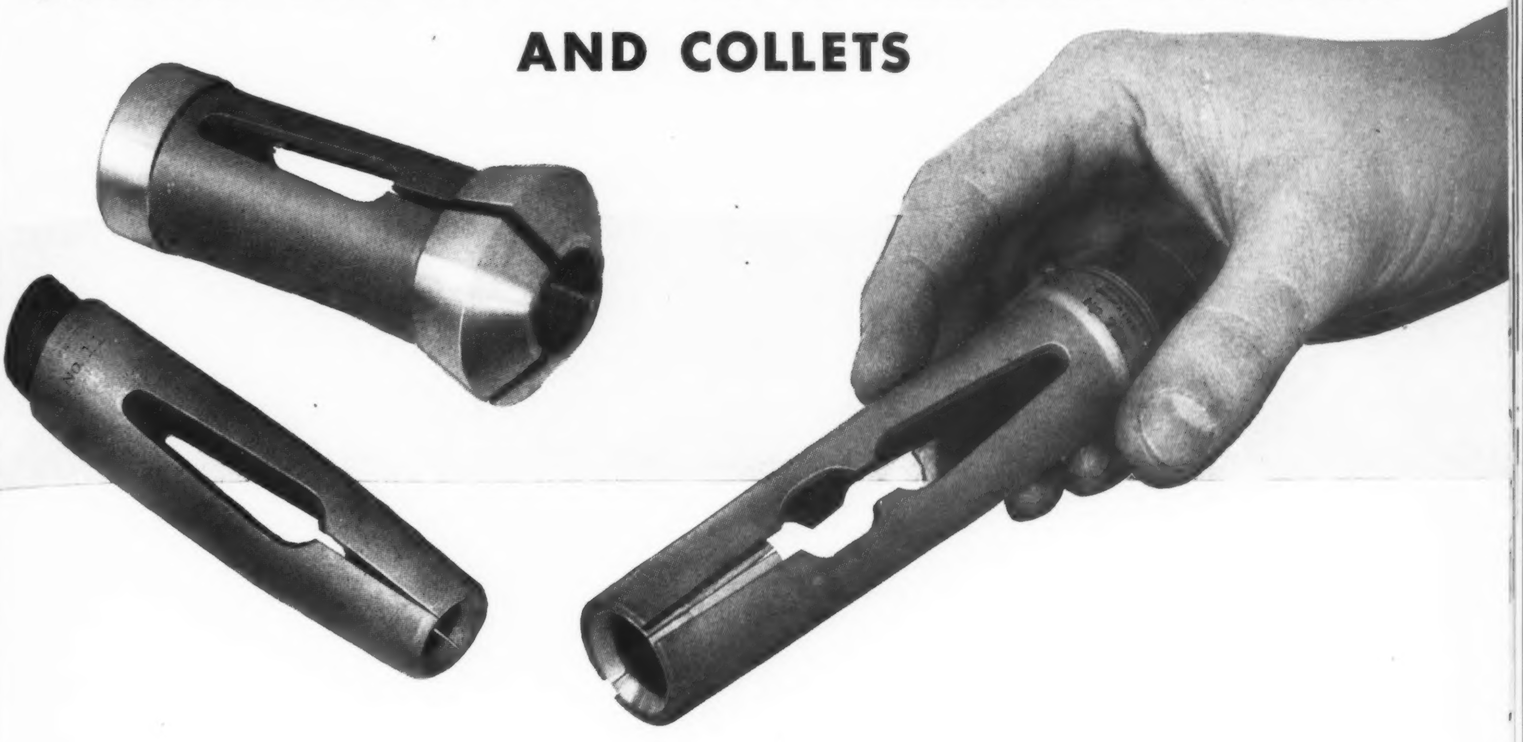


Bliss Geared Type Inclinable Press

Graphite Lubricant for Lathe Center

A new lubricant for the dead centers of lathes has been developed by the Joseph Dixon

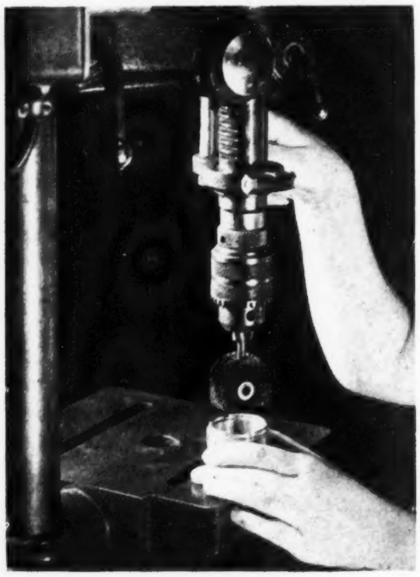
To obtain additional information on equipment described on this page, see lower part of page 214.



Crucible Co., Jersey City, N. J. The product is a combination of pure flake lubricating graphite and other specially formulated lubricants made to withstand the extremely high pressures and temperatures developed at the dead center of a lathe. This new product also has many uses as an anti-seize compound where a lubricant of high film strength is required. It is supplied in 1-, 4-, and 8-ounce collapsible tubes. 85

G-E Alternating-Current Starters

A new line of alternating-current combination magnetic starters for the full-voltage starting of induction motors up to 7 1/2 H.P. has been placed on the market by the General Electric Co., Schenectady, N. Y. These starters are now available in NEMA sizes 0 and 1. They consist of a fusible motor-circuit switch and a magnetic starter incorporated in one compact unit to conserve space and installation time, provide greater protection for equipment and operators, and improve the appearance. The starters are enclosed in general-purpose, cabinet type, all-welded steel cases. An interlocking arrangement prevents opening the door until the switch is off. The starters are completely wired, and after being connected, are ready for operation. 86



Drilling Machine Equipped with Osborn Cavity-cleaning Brush

Osborn Brushes for Cleaning Cavities in Metal Parts

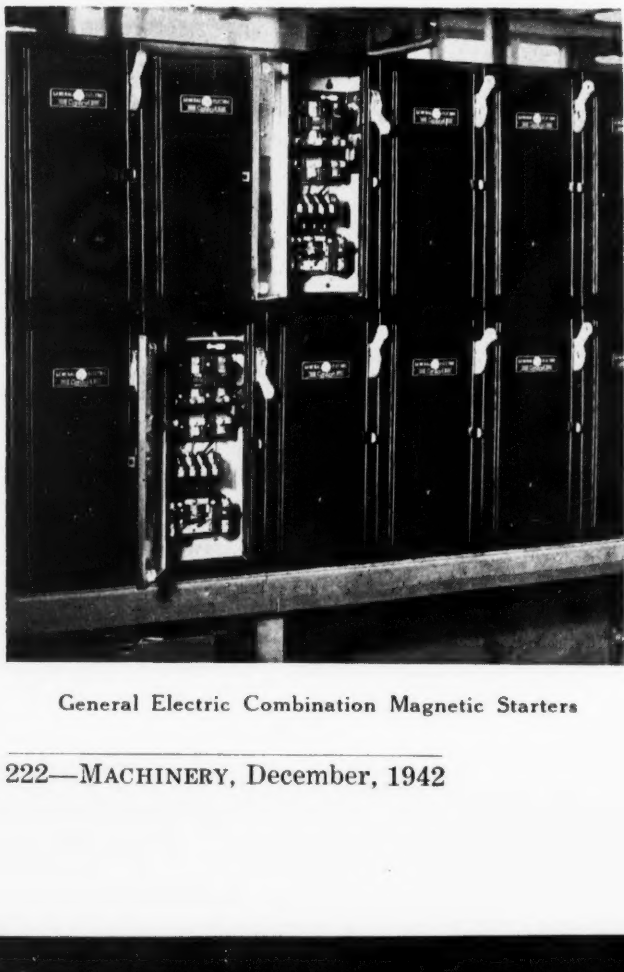
Disk-shaped brushes with two sides and the end trimmed to give two square corners are being produced by the Brush Division of the Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, Ohio, for use in removing rust, scale, burrs, sharp corners, dirt, and chips from metal holes, cavities, and recesses. These brushes, when held in the chuck of a drilling machine and rotated or caused to spin like a coin, will clean both the bottoms and side walls in the cavities of machined, stamped, cast, or forged parts in one operation. The brushes can be used by hand, as well as in machines that operate automatically or semi-automatically. No metal parts extend beyond the working diameter of the brushes to injure the work. 87

Boring Tool with Cushioned Cutter-Pilot

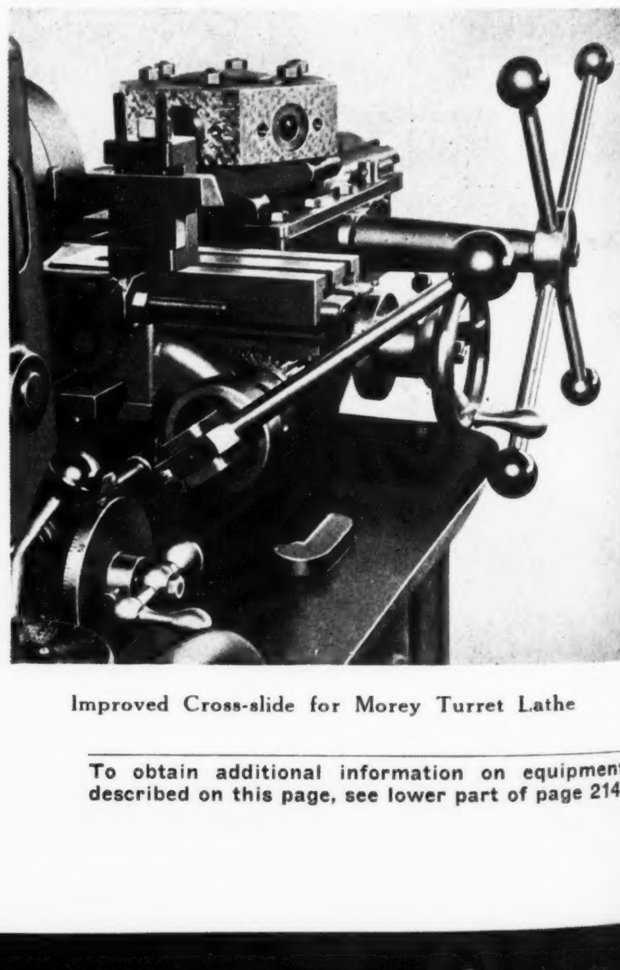
The Industrial Engineering Co., Inc., Board of Trade Bldg., Chicago, Ill., has brought out a cushioned cutter-pilot designed to reduce breakage of carbide tools, especially those used in deep-hole boring where the cutter is advanced into the work away from its main support. The cushioned pilot is placed directly in back of the cutter at the end of the boring-bar when the bar is in its highest position. The boring-bar is supported by a bushing in a fixture attached to the machine. This bushing guides the bar and cutter as it proceeds into the work. 88

Quick-Acting Cross-Slide for Morey Turret Lathe

An improved quick-acting combination screw- and lever-operated cross-slide, designed to enable the operator to instantly change from



General Electric Combination Magnetic Starters



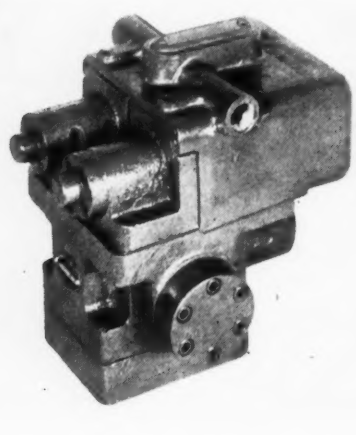
Improved Cross-slide for Morey Turret Lathe

To obtain additional information on equipment described on this page, see lower part of page 214.

one method of feeding to the other, has been developed by the Morey Machinery Co., Inc., 410 Broome St., New York City, for use on the No. 2G turret lathe built by the company. A single but effective quick-acting clutch provides means for making the change from one method of feeding to the other. 89

High-Pressure, Four-Way Valve for Machine Control

An improved four-way valve, brought out by the Hydraulic Hi-Speed Co., 5438 Tireman Ave., Detroit, Mich, permits either closed- or open-center operation by making a slight mechanical adjustment. Used on a machine tool, a production oven, or whenever spring-



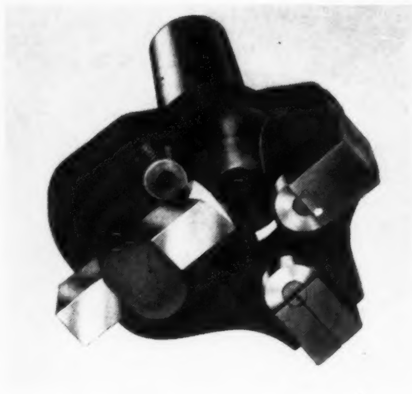
Four-way Valve for Machine Tool Control

centered four-way valve operation is desired, it permits changing to a different type of operation without replacing the valve. All that is required is the removal or installation of a 1/8-inch socket pipe plug.

The valve is available in three models of 10, 18, or 28 gallons per minute capacity, with a maximum recommended working pressure of 2000 pounds per square inch. It is furnished complete with sub-plate and solenoids in a choice of voltage and current characteristics. The need for a separate pilot pressure system is eliminated, since the valve contains an integral dumping valve. 90

Boyar-Schultz Box-Tool

The box type screw machine tool here illustrated has been brought out by the Boyar-Schultz Corpora-

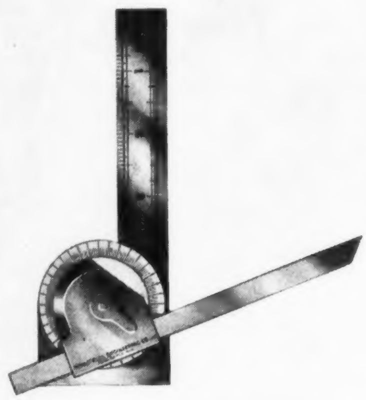


Boyar-Schultz Box-tool Designed for Heavy, Accurate Cuts

tion, 2110 Walnut St., Chicago, Ill., for use in taking heavy accurate cuts. It has a swiveling tool bit and individually adjusted rollers that make possible easy accurate settings. Rigid construction and generous space for chips and coolant are features of this tool. 91

Pocket Protractor for Laying out Angles

A pocket protractor designed as an all-around general-purpose tool for use by designers, machinists, toolmakers, and others in the machine-building industry has been placed on the market by the Industrial Engineering Co., Inc., Board of Trade Bldg., Chicago, Ill. The protractor has an adjustable sliding arm carried by a pivoted segment, and can be swung through an angle of 360 degrees. It can be used for measuring directly small or large surface angles, such as are ground



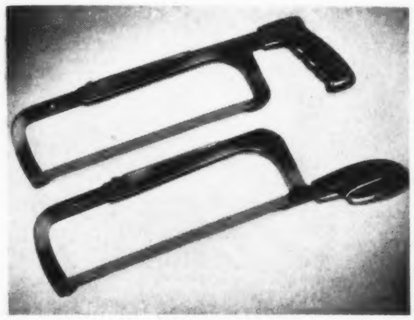
Pocket Protractor Brought out by Industrial Engineering Co., Inc.

on tool bits, without the aid of any attachments.

The taper on shallow blind holes or tooth angles on broaches can be measured by simply sliding the arm of the protractor into position to suit conditions. The degree graduations are arranged so that the component angle, as well as the angle required, can be read. 92

Hacksaw Frame with Cam-Actuated Blade Clamp

All loose blade studs and threaded tension devices have been completely eliminated in a new type of



Victor Hacksaw Frames

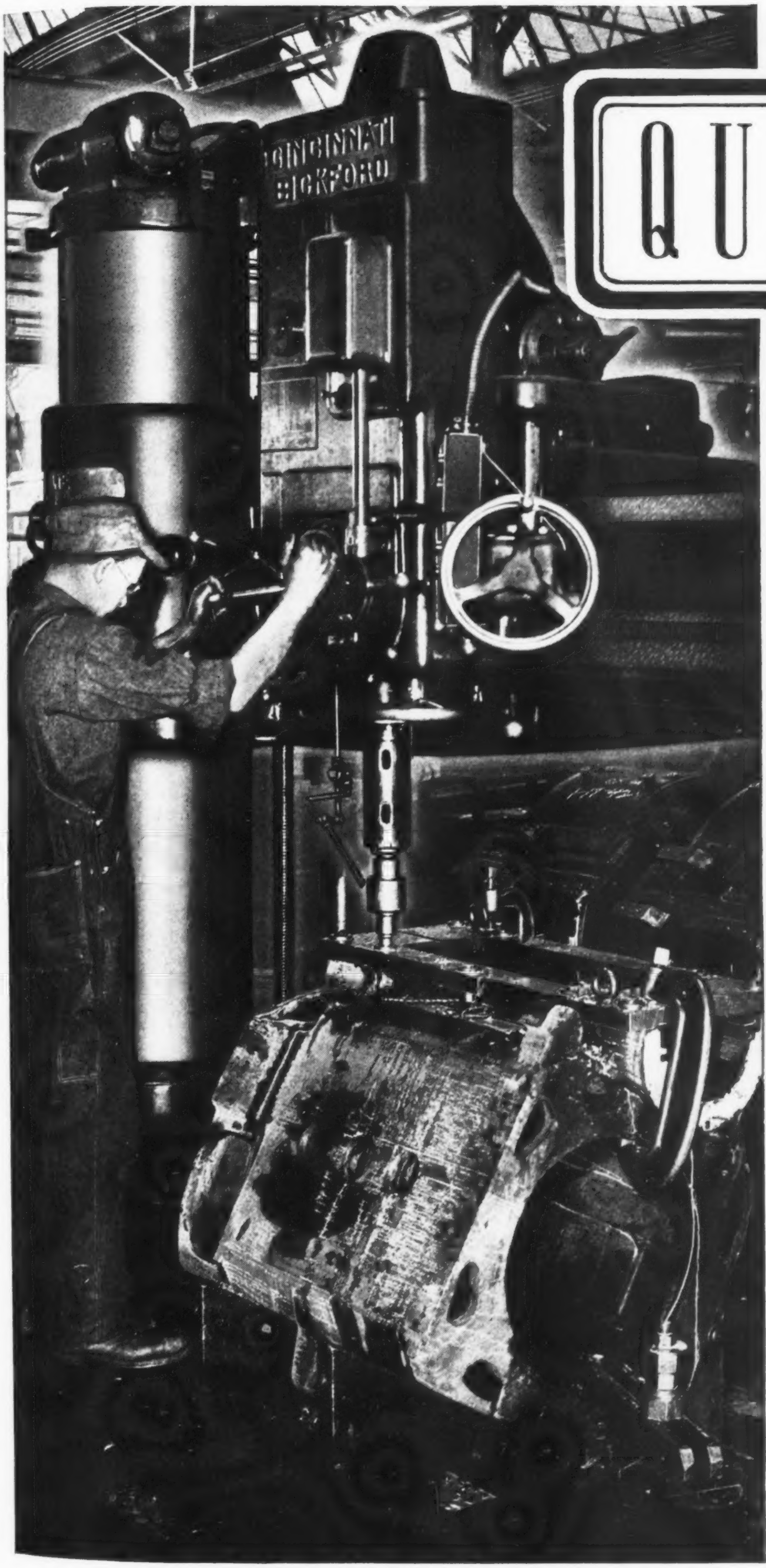
hacksaw frame introduced to the trade by the Victor Saw Works, Inc., Middletown, N. Y. The clamping arrangement of this frame permits the blades to be instantly released or secured by a simple cam-action lever-lock. The adjustable frame, of heat-treated spring steel, is of rigid design and permits high tension to be applied to the blade. It is claimed that this feature results in straighter cuts and fewer broken blades. Gun-metal finish is employed to prevent corrosion.

This hacksaw frame is available with either pistol grip or straight handle, as shown in the illustration. Both handles are of patented design, molded of heat-resistant Tenite. The blade can be positioned to face in four directions, and the frame can be adjusted to take 8-, 10-, or 12-inch blades. 93

"Micro Scale" for Measuring Center Distances

A machinist's scale equipped with a magnifying glass, known as the "Micro Scale," is being manufactured by the Leonard Engineering Co., Capitol View, Md., and distributed by the L. V. Fox Co., Inc.,

To obtain additional information on equipment described on this page, see lower part of page 214.



QUALITY

YOUR ONE SOLID ASSURANCE OF SPEED AND ACCURACY FOR

WAR

PRODUCTION

Illustrated is a typical application of the SUPER SERVICE RADIAL to wartime production. The job calls for operations on motor frames for Diesel-electric switcher-engines . . . vital jobs, because the War Department, the Navy Department, Arsenals and many large manufacturers require these engines to speed essential transportation. For work of this character the SUPER SERVICE RADIAL is almost a standard. You'll find these famous Radials on the job, 3-shifts-per-day, 7 days a week, in countless war production plants from coast to coast. The Quality of their design —the Quality of their workmanship and construction — the Quality of their performance is such that the name "Cincinnati Bickford" on a Radial is sufficient to assure top operating speeds, unexcelled accuracy and "more holes per dollar."

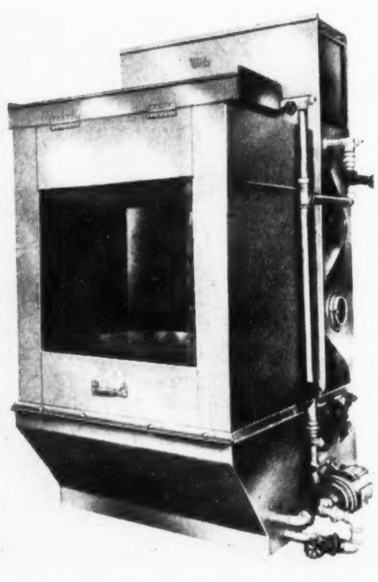
THE CINCINNATI BICKFORD TOOL CO. OAKLEY, CINCINNATI, OHIO, U. S. A.

Washington, D. C. With this new scale a sixty-fourth inch division appears about four times its normal size. This permits the toolmaker to easily work to a few thousandths of an inch, since he can readily estimate or split a sixty-fourth division. The scale is constructed to lie flat on the surface block, has a patented unbreakable plastic lens, which focusses and slides along the scale, and can be carried flat in the pocket. 94

Aqua-Restor Water-Wash Paint Spray Booth

A single-compartment paint spray booth with rear and side water-impingement walls has been developed by the Aqua-Restor Division of the Mayer Mfg. Corporation, 45 Division Place, Brooklyn, N. Y. The super-turbulent water-washed walls, through continuous pressure flow, provide for the efficient spraying of all sizes and types of work. This equipment is designed to protect employe health and reduce fire hazards to a minimum.

The makers of this equipment claim that the absence of spray nozzles eliminates the possibility of clogging and that only low-horsepower pumps are required. The used water can be drained directly or pumping equipment can be provided for disposal of the water at a distant point. The equipment illustrated is equipped with turntable and fluorescent lighting, and is available in multiple units. 95



Aqua-Restor Paint Spray Booth

Controlled Materials Plan Adopted

The War Production Board has announced a plan for the control of materials used in war and essential civilian production, to be known as the "Controlled Materials Plan," which is expected to replace much of the present priorities system. The new plan will go into effect on July 1, 1943. It is devised to "cut out all non-essential production, military and otherwise." It will be directed by the vice-chairman of the War Production Board, Ferdinand Eberstadt. The purpose of the plan, which will be known as CMP, is to make certain that production schedules are adjusted to the supply of materials; in other words, to insure that there will be a proper balance between available materials and production schedules. Briefly, the plan is described as follows:

1. The War Production Board Requirements Committee will allot controlled materials to seven "claimant agencies" on the basis of supplies available and military need.
2. The claimant agencies—Army, Navy, Maritime Commission, Aircraft Scheduling Unit, Lend-Lease, Board of Economic Warfare, and Office of Civilian Supply—will, in turn, make allotments to prime contractors producing essential goods.
3. These contractors will divide their allotments among their subcontractors and suppliers.

As in previous plans for the control of materials, manufacturers will be expected to provide the Government with information as to the materials required for essential production, so that proper allotments can be made in time for all war production needs.

"Invisible Gloves" to Protect Workers' Hands

Many substances have been developed for the protection of the hands of workers in machine shops to guard them against the effects of acids, oils, greases, paints, solvents, etc., that cause skin irritation and infections, and against dirt and grit difficult to remove by ordinary washing or cleaning of the hands. The Cadet Creme Co., Worcester, Mass., has produced a protective covering for the hands of workers exposed to non-water carrying contaminating liquids and acids. This material is known as "Cadet Protector Creme."

This greaseless substance, applied to the clean skin before starting to work, dries and forms an invisible film or protective coating that prevents acids, oils, greases, and grime from adhering to the skin. Carbon tetrachloride, ether, naptha, oils, thinners, and similar materials do not dissolve or penetrate this protective coating. One coating is said to last for at least four hours. To remove the "invisible gloves" with the accumulations of grime and dirt, all that is necessary is a small quantity of water.

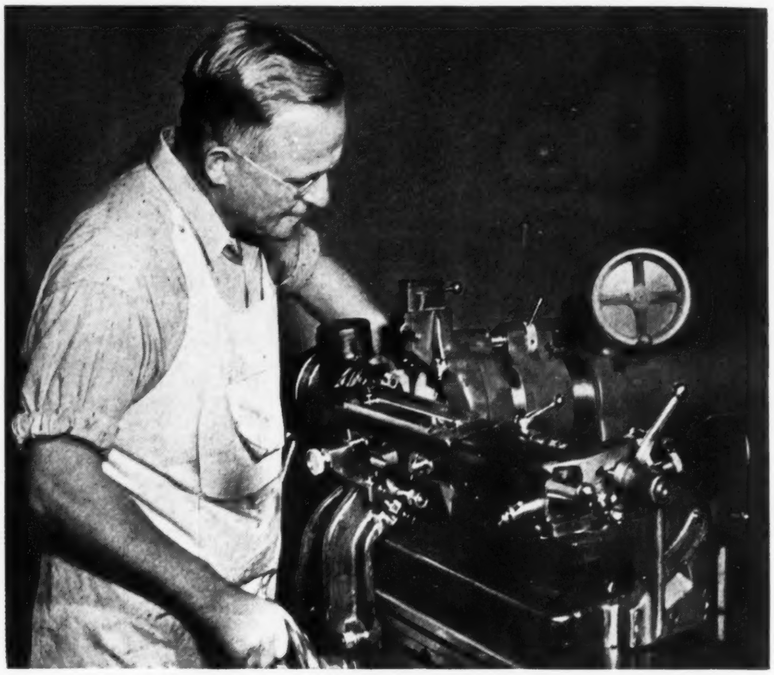
A waterproof protective cream is also made for use by electroplaters, textile workers, and others who ordinarily would use rubber gloves for skin protection. In most cases a coating of this cream will replace rubber gloves satisfactorily. This "Waterproof Creme" is removed by first using the "Cadet Protector Creme," and then slowly rinsing the hands with hot or cold water.

Treasury Department Initiates New Drive for Payroll Savings Campaign

The Treasury Department, in cooperation with business and manufacturing concerns and labor organizations, has initiated a special payroll savings campaign to increase the number of wage-earners regularly buying War Savings Bonds from the present total of approximately 21,000,000 to 30,000,000. Nearly 7000 business and industrial companies have already become issuing agents for Series E Bonds. Firms that are not already maintaining payroll savings plans are urged to do so. All employers who want to aid in the drive and who can qualify for this service are asked to communicate with the War Savings Bond Division, Treasury Department, Washington, D. C.

To obtain additional information on equipment described on this page, see lower part of page 214.

Faster Method for Sharpening Gun-Chamber Reamers



Barber-Colman Combination Sharpening Machine Equipped with Special Fixture for Sharpening Gun-chamber Reamer

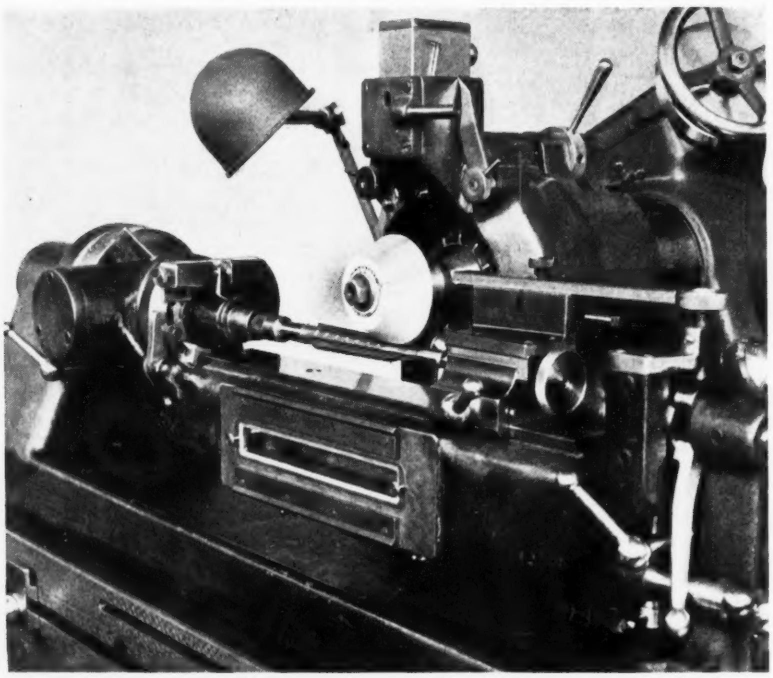
CHAMBERING a gun barrel is usually accomplished by a series of reaming operations which includes roughing, semi-finishing, and finishing. The reamers used must be made to extremely close tolerances on certain tapers and diameters, in order to produce a chamber in which the cartridge will be an accurate fit. It is also essential that the chamber have a very fine finish.

The problem of sharpening gun-chambering reamers involves exacting requirements, especially with respect to the portions of the reamers that form the body, shoulders, and neck tapers. Grinding the reamer blades with the correct amount of face hook and with the cutting edge parallel with the axis of the reamer to close limits of accuracy is a necessary requirement. The cartridge chamber must be perfectly smooth and free from any surface irregularities, as the firing of the explosive charge creates a tremendous force that expands the cartridge case in the chamber of the gun barrel. If the cartridge case should be forced by the explosion into rings in the surface of the chamber left by rough-reaming operations, serious difficulty would be encountered in ejecting the fired shell. Thus smooth operation of the gun would be greatly impaired.

Coupled with this necessity for accuracy is that of rapidly restoring the reamers to service when they become dull. The sharpening must also be done in such a manner as to insure uniform results and maximum production between sharpening operations.

The Barber-Colman Co. has recently announced a new, faster method for sharpening bore reamers or reamers with connecting tapers which has been developed by G. A. DeVlieg of that company. The new method provides complete mechanical control of the sharpening operations, and insures positive duplication of results obtained by the original sharpening operation. This method was developed primarily for the sharpening of reamers used in finishing cartridge chambers.

In actual production, this method has been found to reduce the time required for sharpening chamber reamers to approximately 30 minutes. Reamers sharpened by this method are also capable of finishing up to 300 chambers between sharpening operations. This increase in production is attributed to the uniformity of tapers and clearances made possible by sharpening with



Fixture and Machine Set up for Face Sharpening and Correction of Gun-chamber Reamer

Announcing

A Series of 6 TRAINING FILMS

For your use in the training of new men, apprentices, and personnel being converted to war work

on DESIGN, BRAZING, APPLICATION, GRINDING OF CARBIDE TOOLS

We announce—for use in your plant—a series of six training films covering the fundamentals of carbide tool manufacture, design, brazing, application and grinding. Based on more than a decade of experience in the art of cemented carbide use, the films are designed to speed the training of new men, apprentices, and those being converted to carbide tool use in the metal working industry. Also suitable as "refresher courses" for those with working knowledge of carbide tool use but who wish to review the latest techniques. Technically known as "film strips" —containing illustrations and explanatory text—these films are designed for step-by-step training in the following subjects:

Not Motion Pictures
Carboloy training films are technically known as "film strips", or silent slide films (35mm), containing illustrations and explanatory text for detailed training purposes.

SUBJECTS

Film No. 1—"WHAT IS CEMENTED CARBIDE?"

Designed to provide a knowledge of what cemented carbide is, physical characteristics, and how made. Valuable as a basis for understanding reasons for recommendations in subsequent films.

Film No. 2—"DESIGNING CARBOLOY TOOLS"

Reviews for tool designers, the special requirements necessary in designing tools with carbide tips. Covers tool styles, tip and shank sizes, rakes, etc., for single point tools.

Film No. 3—"BRAZING CARBOLOY TOOLS"

Detailed, step-by-step procedure for torch brazing carbide blanks to steel shanks. Includes brazing of single and multiple point tools, how to renew worn-out H.S.S. cutters with carbide tips, etc.

Film No. 4—"CHIP BREAKERS"

Shows how to determine most efficient chip breakers for carbide steel cutting tools; how to adjust to meet individual conditions; and step-by-step procedure for grinding rapidly and accurately.

Film No. 5—"GRINDING CARBOLOY TOOLS"

Step-by-step grinding procedure for single point carbide tools from brazed, damaged and ordinary dulled states. How to rough rapidly and finish accurately. Equipment, wheels, accessories.

Film No. 6—"PUTTING CARBOLOY TOOLS TO WORK"

Important for the operator applying carbide tools. In three parts: Part I—Putting tool on machine. Part II—The machine. Part III—Trouble shooting. What to do when the job doesn't "click".

AVAILABLE FOR PERMANENT USE AT COST OF PRINTS ONLY

So that industrial concerns and educational institutions may incorporate these films as a permanent part of their war training program, prints are available for purchase at approximate print cost of $20.00 for set of 6. (Entire cost of film production has been absorbed by Carboloy Company.) One complete set of six reference manuals and one instructor's manual included.

CARBOLOY COMPANY, INC., DETROIT, MICH.

(Sole makers of the Carboloy brand of cemented carbides)

Chicago · Cleveland · Los Angeles · Newark · Philadelphia · Pittsburgh

MAIL THIS COUPON TODAY!

Carboloy Company, Inc.
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☐ Send free booklet describing Carboloy Training Films.

☐ Reserve 1 set of 6 films @ $20.00, including set of film reference manuals and instructor's manual. Order follows.

Name______ Title______

Company______

Company Address______

City______ State______

CARBOLOY TRADEMARK **CEMENTED CARBIDES**

the operations always under complete mechanical control.

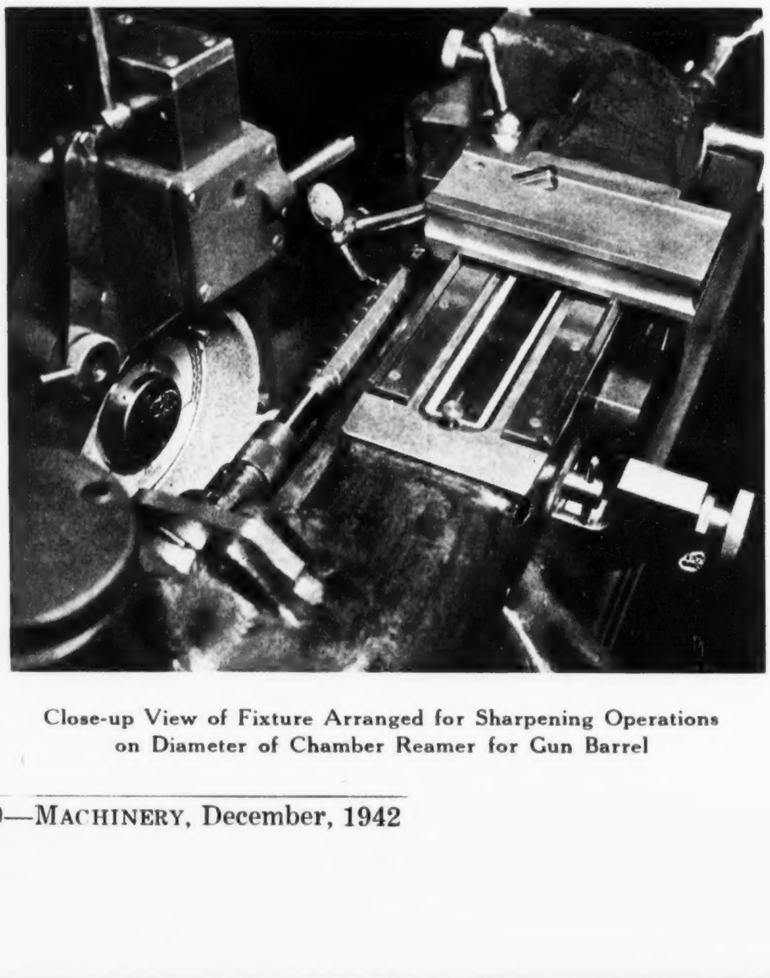
This method, which results in sharpening with greater speed, economy, and improved accuracy, has also helped to increase the production of guns, because it involves only the application of a special fixture to a standard Barber-Colman combination sharpening machine, such as was described in September, 1938, MACHINERY, page 51. This is important to manufacturers because it enables them to use existing standard equipment and to eliminate the long, tedious process of hand-stoning the reamers.

In the past, chamber reamers have been cylindrically ground to diameter, and then stoned by hand until a suitable cutting edge was obtained. The operation of hand-stoning consumed two to five hours, depending on the skill of the workman. The number of pieces produced per sharpening by this hand method varied from twenty-five to seventy-five, depending upon the kind of cutting edge obtained by the hand-stoning operation.

Up to the present, the fixture shown in the accompanying illustrations has been adapted to the sharpening of chamber reamers for 20-millimeter and 0.30- and 0.50-caliber guns. Suitable cams for developing reamers of the correct form for the various tapers in the gun chambers have been incorporated in the fixture, which is designed to be mounted on the sharpening machine.

Assuming that the reamer has originally been designed correctly, these cams will automatically control the sharpening operation, so that the tapered sections will be sharpened to the correct diameters. The fixture is also adjustable for face sharpening to correct any variations in face hook or to compensate for out-of-parallelism of the cutting flutes with respect to the reamer axis.

The combination sharpening machine used is of the standard Barber-Colman design employed for sharpening hobs, cutters, or reamers. No special skill is required to operate the machine, and in many plants this work is being done by comparatively inexperienced women operators. In one case where the combination sharpening machine and fixture is being used, eight men employed in hand-stoning operations were released for other work.



Close-up View of Fixture Arranged for Sharpening Operations on Diameter of Chamber Reamer for Gun Barrel

* * *

Research Office of War Production Board

The War Production Board has established an Office of Production Research and Development, with Dr. Harvey N. Davis, president of Stevens Institute of Technology, as its director. This office has been set up to insure rapid appraisal and utilization of processes, materials, mechanisms, and inventions in the production of war goods. The principal functions of the new office will be to provide technical information on research and development work in progress in the War Production Board; and to initiate analyses of specific scientific or technological proposals, through the establishment of expert committees or through reference to existing research groups in Government, education, or industry.

The new office will also get needed research accomplished by contracting with outside laboratories or agencies for experimental work, and will bring about development of such projects or processes as are found to merit it by contracting for the construction of equipment or the erection of pilot plants.

* * *

New Officers of the International Acetylene Association

At its recent annual meeting in Cleveland, Ohio, the International Acetylene Association elected the following officers: President, Ellsworth L. Mills, vice-president, Bastian-Blessing Co., Chicago, Ill.; vice-president, Glenn O. Carter, consulting engineer, The Linde Air Products Company, New York; secretary, Herbert F. Reinhard, Union Carbide and Carbon Corporation, New York City, who will serve as secretary for the eleventh time; and treasurer, Philip Kearny, president, K-G Welding & Cutting Co., New York City.

* * *

Army-Navy "E" Production Awards

Among the latest additions to the growing list of companies whose outstanding achievements in war production have been recognized by the award of the Army-Navy "E" are the following: American Welding Co., Carbondale, Pa.; Armstrong Cork Co., Lancaster, Pa.; Atlas Press Co., Kalamazoo, Mich.; South Bend Lathe Works, South Bend, Ind.; Standard Gage Co., Poughkeepsie, N. Y.; and Sunnen Products Co., St. Louis, Mo.

Bright Colors in Factories

When the war is over and manufacturers are again free to make use of any desired color in painting machinery, it is possible that there will be a trend toward lighter colors. After a year's experience with painting machinery in lighter shades, the du Pont organization states that users report increased production (as much as 15 per cent in many cases) and fewer accidents by using contrasting colors in lighter shades. In one instance, for example, the machine is painted machine tool gray, but the operating parts of the machine are painted light buff or light green. The idea is that it makes it easier for the worker to observe what he is doing when he sees the working parts of the machine in contrasting colors.

On the basis of extensive research, especially in aircraft factories, the du Pont organization recommends soft light-reflecting colors for factory floors, so that the light will reflect and assist the workers when occupied on the under surfaces of, say, aircraft wings. By changing the colors of machines, floors, walls, and ceilings, increases of as much as 100 per cent in shop illumination have been achieved.

Chip-Breaker Groove of Radical Design for Machining Stainless Steel

A difficult problem in machining stainless steel has been solved by the Firth-Sterling Steel Co., McKeesport, Pa. The material machined was soft but extremely tough, and it was necessary to cut through the scale in a rough-turning operation. Although various methods of grinding the tools were tried, including the grinding of negative top and side rakes, positive rakes with negative lands, parallel and angular type chip-breakers, and even dulling the cutting edge at the scale line, the tools invariably chipped at the scale line or were worn away at that point after being in operation only five minutes or so.

The solution of this problem consisted of reversing the angle of the chip-breaker. The usual practice in grinding carbide tools for cutting steel is to make the chip-breaker wide at the nose of the tool and taper the groove off in the direction of the shank, as shown in the view to the left in the accompanying illustration. Reversal of this method of grinding, as indicated in the view to the right, gave the desired results. The chip-breaker, as shown in this view, was ground to an angle of 7 degrees, with the narrow end of the groove starting at the nose radius. The object in grinding the tool in this manner was to cause the chip cleavage to occur further ahead of the cutting edge at the scale line instead of at the nose radius.

This method of grinding the tool prevented edge failure, even at double the feed and speed formerly used. A tool life of eight hours was secured at a speed of 200 feet per minute and a feed of 0.012 inch per revolution, using Grade HA Firthite without a cutting fluid.

* * *

Our aviators, soldiers, sailors, and marines have no chance to question the number of hours that they are on duty when they risk their lives for the safety of all of us who stay at home.

Typewriters Needed

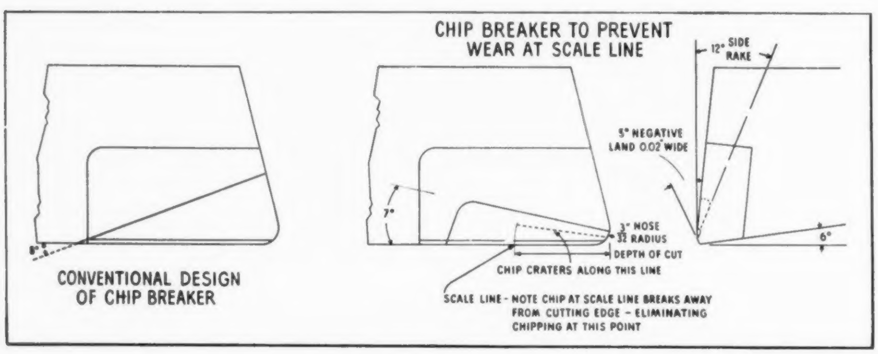
The Army, Navy, and other war agencies require 600,000 standard size typewriters built since January 1, 1935, in order to carry on their work more effectively. The Government expects to obtain the larger part of these machines from American business concerns in manufacturing plants. The typewriter-manufacturing companies have been converted to arms production, and only one small unit is manufacturing typewriters to an amount less than 5 per cent of the normal output; hence, new machines are not available.

It is estimated that there are 2,400,000 of the type of machines required in American business offices and manufacturing plants, and the Government is asking every concern owning typewriters to release a portion of these for Army and Navy use. Typewriters offered will be purchased by the Treasury Department, Procurement Division. The Treasury Department has designated dealers in new and used typewriters and manufacturers' representatives as official purchasing depots. These dealers have signs in their windows indicating that they act for the Government.

* * *

Inspectors of Materials and Equipment Wanted by the Maritime Commission

The expansion of the activities of the United States Maritime Commission in constructing cargo and other ships for war purposes, and in producing the materials and equipment for outfitting them, has created the need for additional inspectors. Persons with industrial experience in manufacturing or inspection are requested to communicate with the U. S. Civil Service Commission, Washington, D. C.



Diagrams Showing Conventional Chip-breaker Design, and Chip-breaker as Ground for Machining Stainless Steel

A Light Still Burning

Someone has said that the *lights* of civilization are all going out, and so it would seem.

There is, however, one *light* that burns with ever increasing radiance and that one *light* is destined to light anew all the rest.

This month we are again reminded of that *light* and the soul uplifting hand for which it stands. And it is with that thought and in that spirit that The Sidney Machine Tool Company would with you observe Christmas.

THE
SIDNEY MACHINE TOOL COMPANY
SIDNEY, OHIO

NEWS OF THE INDUSTRY

Massachusetts

CARL A. SALMONSEN has been appointed assistant manager of the Lynn, Mass., River Works of the General Electric Co. Mr. Salmonsen has been with the General Electric organization since 1909, when he entered the employ of the company as an office boy at Schenectady. Two years later he took the G-E apprentice machinists' course. From then on he was advanced steadily, until in 1925, he was made superintendent of the punch press work for the company. In 1928, he was sent to the Peterborough Works of the Canadian General Electric Co., Ltd., as general superintendent, and two years later became manager of that plant. Since 1941 he has been in charge of one of the manufacturing divisions at the Lynn Works.

Carl A. Salmonsen, New Assistant Manager of General Electric Lynn Works

W. T. Cushing, Newly Appointed Detroit Branch Manager of Bay State Abrasive Products Co.

GEORGE M. STEVENS has been appointed acting manager of the River Works of the General Electric Co., and NICHOLAS M. DU CHEMIN acting manager of the West Lynn Works, both at Lynn, Mass. Mr. Stevens and Mr. Du Chemin succeed the late Nelson J. Darling, who was manager of both plants for several years.

EARL WESSELHOFF has been made manager of the Boston branch of the Morse Chain Co., Ithaca, N. Y., succeeding C. L. PRATT, JR., who has resigned. Mr. Wesselhoff was previously located at the Detroit plant, where he started twenty-two years ago as automotive timing chain drive engineer.

GEORGE D. GILBERT has been appointed general manager of the Baldwin-Duckworth Division of the Chain Belt Co., which division operates plants in Springfield and Worcester, Mass., manufacturing roller chain and sprockets. WILLIAM H. GATES has been appointed works manager of the Baldwin-Duckworth Division.

Michigan

HYDRAULIC MACHINERY, INC., has started construction on a new plant at 12801 Ford Road, Dearborn, Mich. The new building will combine under one roof the activities formerly carried on in the plants at 833 Elizabeth St. and at American Ave., as well as at the general offices at 10421 Grand River. It will have a floor area of 17,500 square feet, which will result in increasing the capacity of the concern about 75 per cent.

A. E. SHELTON, formerly works manager of the Stinson Division of Vultee Aircraft, Inc., Detroit, Mich., has been promoted to the newly created position of division manager. Before becoming connected with the Vultee organization, Mr. Shelton was president and general manager of the Menasco Mfg. Co., Burbank, Calif. He has had twelve years' experience in the aircraft industry.

BOKUM TOOL CO., Detroit, Mich., is now located at 14775 Wildemere Ave., where the company occupies a modern building having a floor space several times the area of its former quarters. The event marks the third expansion of the company since it was organized by Fred Heuser, its president, in 1931.

D. A. MACKINNON has been appointed hydraulic sales engineer of Hydraulic Machinery, Inc., 10421 Grand River, Detroit, Mich. Mr. MacKinnon's experience in the field of hydraulics covers a five-year period with Vickers, Inc., and six years with the Sundstrand Machine Tool Co.

New Jersey

DAN C. HUNGERFORD, previously vice-president and a director of the Elastic Stop Nut Corporation, Union, N. J., has been elected president and general manager of the Aircraft Parts Development Corporation, 409 Broad St., Summit, N. J.

THOMAS H. CORPE has been made general sales manager of the Elastic Stop Nut Corporation, Union, N. J. Mr. Corpe was formerly assistant general sales manager of the Lockheed Aircraft Corporation.

New York

GERARD SWOPE, president of the General Electric Co., Schenectady, N. Y., has been awarded the Hoover Medal, which is administered by representatives of the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers. The medal will be presented to Mr. Swope during the convention of the American Institute of Electrical Engineers in New York City in January. It is awarded for constructive public service.

STRIPPIT CORPORATION is now located in its new plant at 345 Payne Ave., North Tonawanda, N. Y. The capacity of the plant will enable the company not only to accelerate deliveries on the hole-punching and notching units built in the past, but also to begin the manufacture of a number of new products that will speed up production and reduce costs in metal fabrication.

CHARLES D. YOUNG, formerly district manager of the Chicago office of

the Metal & Thermit Corporation, has been appointed sales manager of the welding division, with headquarters at 120 Broadway, New York City. Mr. Young has been connected with the organization since 1912. He is a graduate of the Armour Institute of Technology.

EDWARD S. COE, JR., has been appointed manager of the New York office at 79 Wall St. of the Farrel-Birmingham Co., Inc., Ansonia, Conn. Mr. Coe succeeds the late E. H. Thomas. He has been connected with the company since 1936, and for the last few months has been in charge of expediting production of Farrel-Sykes gear-generating machines.

FELIX A. SCHAGELIN, assistant to W. Austin Commerdinger, vice-president in charge of production of Byrne, Mitchell & Co., Inc., 70 Pine St., New York City, has also been appointed chief engineer of the Industrial Electronic Corporation, Brooklyn, N. Y., designer and builder of tools, jigs, fixtures, dies, gages, and special machines.

WILLIAM F. MCCARTHY, vice-president of Henry Prentiss & Co., New York City, was tendered a testimonial dinner on November 16 by the Metropolitan Machine Tool Dealers at the Advertising Club of New York. A. G. BRYANT, former president of the Associated Machine Tool Dealers of America, was the chief speaker at the dinner.

E. P. BARRY has been appointed coordinator of plants for the Chicago Pneumatic Tool Co., 6 E. 44th St., New York City. He will supervise the machine equipment, tool designing, and production methods at the company's plants in Detroit, Mich.; Cleveland, Ohio; Franklin, Pa.; and Garfield, N. J.

MERRITT L. SMITH, advertising manager of the Metal & Thermit Corporation, 120 Broadway, New York City, has been appointed assistant sales manager. He is a graduate of Columbia University and has been with the corporation for ten years.

J. L. TOWNSEND has been made assistant manager of sales, fractional-horsepower motor section, of the General Electric Co.'s Motor Division. He joined the company as a student engineer at the Fort Wayne Works in 1925.

GROBET FILE CO. OF AMERICA, distributor of Swiss pattern files and rotary files, has removed to larger quarters at 421 Canal St., New York City.

H. J. THELEN BRONZE CO., INC., is now located at 28-30 Quincy St., Brooklyn, N. Y.

Ohio

J. E. VON MAUR has been appointed representative of the American Gas Furnace Co., Elizabeth, N. J., throughout the state of Ohio. Mr. von Maur will have offices at 63 S. High St., Columbus, Ohio, and 715 Prospect St., Cleveland. The VERKAMP CORPORATION, of Cincinnati, will act as his sub-representative in southwestern Ohio.

ALLEN P. LIVAR has been appointed chief engineer of the Airtemp Division, Chrysler Corporation, Dayton, Ohio. Since 1937, he has been chief heating engineer, and in his new capacity will take over the duties of R. G. WYLD, who has become a Lieutenant, Senior Grade, in the U. S. Navy.

DR. H. B. OSBORN, JR., research and development engineer of the Tocco Division of the Ohio Crankshaft Co., Cleveland, Ohio, which company has developed the widely used Tocco process for heat-treating steel, recently addressed the Electrochemical Society of Cleveland on "Surface Hardening by Induction."

Pennsylvania and Washington, D. C.

CHESTER D. MOORE has recently been appointed industrial relations manager of the Sharon Transformer Division of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Mr. Moore was previously supervisor of industrial relations at the Merchant Marine Works of the Westinghouse South Philadelphia plant. In his new position, he replaces J. T. BURKE, who has been transferred to the Canton Division of the company.

Dr. DONALD S. FREDERICK, of the Rohm & Haas Co., Philadelphia, Pa., was recently presented with the annual John Wesley Hyatt Award for an outstanding contribution to the plastics industry. Dr. Frederick was honored for his work in adapting transparent, colorless acrylic plastics, known by the trade name "Plexiglas," to the needs of American military aircraft.

OLIVER SMALLEY was re-elected president of the Meehanite Research Institute of America, Inc., at a recent meeting of the Institute in Pittsburgh. This meeting was attended by over one hundred representatives of Meehanite foundries in the United States and Canada.

PROFESSOR E. L. MIDGETTE has been appointed consultant for the American Engineering Co., Philadelphia, Pa. He will also retain his post as professor of machine design at the Polytechnic Institute of Brooklyn.

W. E. GRIFFITHS has been appointed assistant manager of sales, flat rolled products, of the Allegheny Ludlum Steel Corporation, Pittsburgh, Pa. He was formerly manager of the product development department.

FLOYD TODD has joined the laboratory staff of the Quaker Chemical Products Corporation, Conshohocken, Pa., in a research capacity. His initial work will be in the field of metal corrosion.

A. H. PHILPOT, metallurgical engineer, has been made manager of the Washington, D. C., district office of the Copperweld Steel Co., Warren, Ohio. Mr. Philpot will handle the sale and application of the company's alloy and tool steels.

Texas

LESTER M. COLE, district manager of the Warner & Swasey Co. at Houston, Tex., has been elected a director of the American Society of Tool Engineers for a two-year term. Mr. Cole became connected with the Warner & Swasey Co. in 1925 as a tool designer and estimator. He has been manager of the company's Houston office since 1928.

Wisconsin and Illinois

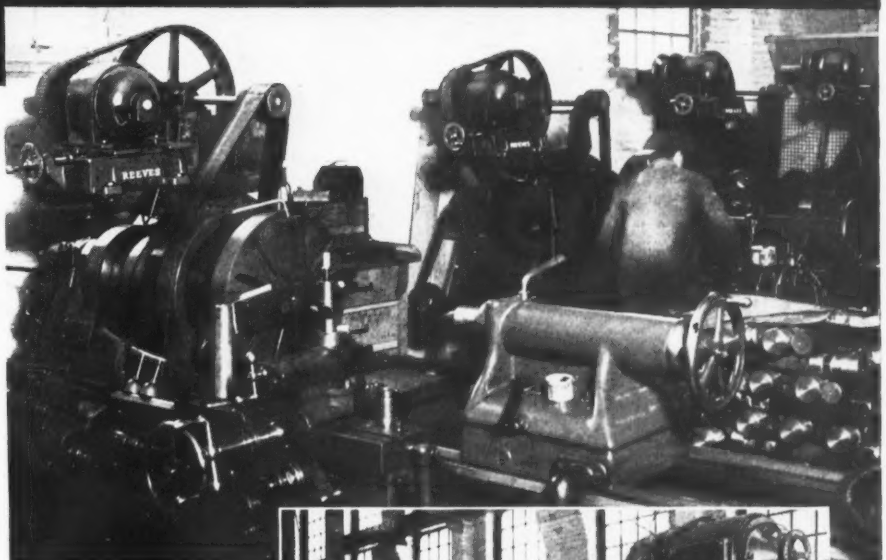
EDWIN H. BROWN, engineering vice-president of the Allis-Chalmers Mfg. Co., Milwaukee, Wis., has been appointed assistant chief of the Iron and Steel Branch of the War Production Board, in charge of the Plant Facilities Section. He succeeds DON N. WATKINS, who resigned to return to his post as president of Steel Publications, Inc. Mr. Brown has been granted an indefinite leave of absence, in order that he may fill his new duties. FORREST NAGLER, chief mechanical engineer, will be in charge of the Allis-Chalmers engineering and development department during Mr. Brown's absence.

Dr. WILLIAM MONROE WHITE, manager of the hydraulic turbine department of the Allis-Chalmers Mfg. Co., Milwaukee, Wis., has retired and is succeeded by J. FRANK ROBERTS. H. P. BINDER becomes manager of the centrifugal pump department. Mr. Roberts became connected with Allis-Chalmers in 1919, remaining until 1927, when he left to join a Canadian corporation. Since 1938, he has been with the Tennessee Valley Authority. Mr. Binder became associated with the company in 1911.

JOHN H. REICHWEIN has been promoted from the position of assistant superintendent to superintendent of the Janette Mfg. Co., Chicago, Ill., manufacturer of electrical machinery.

NEW LIBERTY SHIP ENGINES

from scratch in 90 days



...with Old Machines Equipped with REEVES Variable Speed Drives

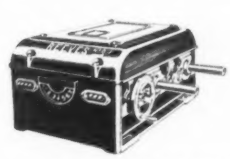
Views of plant featured in this advertisement, showing lathes equipped with REEVES Variable Speed Drives. Approximately 20 REEVES units are in use in this one plant, including the Motodrive, Transmission, and Vari-Speed Motor Pulley.

A group of industrialists in a West Coast city wanted to help meet the government's call for more ships. They had a plant—they had the experience—they had the backing. They were offered an order for triple-expansion main propulsion engines for Liberty Ships. But, they didn't have enough machine tools—and new tools were not to be had. There was no time and little material for building new tools. So they took old, obsolete machines—the only kind they could get—equipped many of them with REEVES Variable Speed Drives for complete speed adjustability, and went to work.

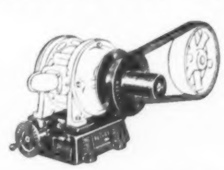
Within 90 days the first engine was delivered. Today a steady stream of engines is being turned out. This record is certainly a tribute to American ingenuity and resourcefulness, and REEVES is proud to have had a part in it. . . . Booklet MG-423 gives other examples of how REEVES drives give old machines greater precision and help new operators save time and material. Write for it.

REEVES PULLEY COMPANY
COLUMBUS, INDIANA

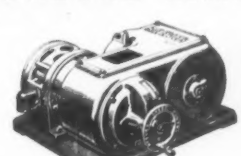
THE 3 BASIC UNITS IN THE REEVES LINE



VARIABLE SPEED TRANSMISSION for infinite speed adjustability over wide range—2:1 through 16:1. Fractional to 87 h.p.



VARI-SPEED MOTOR PULLEY for application to shaft of any standard constant speed motor; 3:1 range. To 15 h.p. Forms actual drive to machine.



MOTODRIVE—Combines motor, variable speed drive and gear reducer (if needed) in one compact unit. To 10 h.p.; speed range 2:1 through 6:1.

REEVES *Accurate Variable* Speed Control

Mr. Reichwein has been with this company for the last eight years, and was previously assistant production manager for the Roth Division of the Century Electric Co.

JOHN B. JENKINS has been appointed manager of the Hydraulic Division of the Twin Disc Clutch Co., Rockford, Ill. Mr. Jenkins has been in charge of the company's factory branches at St. Louis, Mo., Tulsa, Okla., and Dallas, Tex., for the last eight years.

HYDRO-ARC FURNACE CORPORATION, builder of hydraulically controlled electric arc melting furnaces, has moved into its new plant at 561 Hillgrove Ave., LaGrange, Ill.

UNITED PRECISION PRODUCTS CO., manufacturer of gages, is now located at 3524 W. Belmont Ave., Chicago, Ill.

COMING EVENTS

DECEMBER 2-4 — WAR CONGRESS OF AMERICAN INDUSTRY at the Waldorf-Astoria Hotel, New York, under the auspices of the National Association of Manufacturers, with general offices at 14 W. 49th St., New York.

DECEMBER 11—Annual meeting of the AMERICAN STANDARDS ASSOCIATION at the Hotel Astor, New York City. P. G. Agnew, secretary, 29 W. 39th St., New York City.

DECEMBER 12 — Annual forum of the TECHNICAL VALUATION SOCIETY in New York City. For further information, address W. C. Fisher, Technical Valuation Society, 33 W. 39th St., New York.

JANUARY 11-15, 1943 — Annual meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Book Cadillac Hotel, Detroit, Mich. John A. C. Warner, secretary, 29 W. 39th St., New York.

* * *

New Heads of the WPB Tools Division

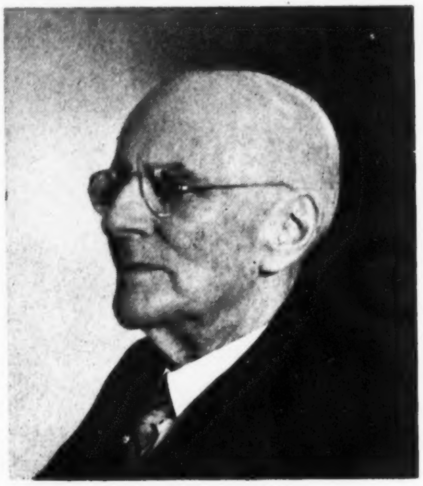
George H. Johnson, president of the Gisholt Machine Co., Madison, Wis., has been appointed director of the Tools Division of the War Production Board, with John S. Chafee, vice-president of the Brown & Sharpe Mfg. Co., Providence, R. I., as deputy director. Mr. Chafee was recently elected president of the National Machine Tool Builders' Association, from which position he has resigned in order to devote himself to his duties in Washington.

OBITUARIES

Charles H. Norton

Charles Hotchkiss Norton, noted inventor in the grinding machine field, who had long been associated with the Norton Co., Worcester, Mass., died in Plainville, Conn., on October 26, at the age of ninety-one years.

Mr. Norton, who was known in industry as the "father of cylindrical grinding," first became associated with the Norton Co. in 1900, at which time the Norton Emery Wheel Co. founded the Norton Grinding Co. with Mr. Norton as designer and chief engineer, so he would be in a position to introduce his methods of cylindrical grinding and to manufacture machines of his invention and design. When the Norton Grinding Co. was merged with the Norton Co. in 1919, he became chief engineer of the Machine Division. Because of his advanced age, he has not been actively associated with the company for a number of years.



Mr. Norton was born in Plainville, Conn., in 1851 and was educated in the public schools of Plainville and Thomaston, Conn. His father was an employe of Colt's Armory in Hartford, Conn., and from him he early absorbed a knowledge of mechanics. At the age of thirteen he started to work at the old Hame factory in Plainville, polishing metal work and thus gaining his first experience with emery wheels. While with this company he conceived the idea of a wheel washer, which was his first invention.

Three years later, he went to work for the Seth Thomas Clock Co., Thomaston, Conn., where he subsequently became foreman and later superintendent of machinery and tower clock design and manufacture. During his twenty years' association with the clock company, he invented and designed special manufacturing machinery and developed many of the fundamental principles on which modern tower clocks are constructed.

In the late '80's, he turned his attention to grinding machines. His first achievement in this field was the successful commercial grinding of the triple cylinders in the Westinghouse air brakes. In 1886, he became assistant engineer at the Brown & Sharpe Mfg. Co., Providence, R. I., later serving as designer and inventor of cylindrical grinding machines for that company. Subsequently, he became partner in the firm of Leland, Faulconer & Norton Co. of Detroit, which became the Cadillac Motor Car Co.

Then came his long association with the Norton Co., where he originated the modern methods of cylindrical grinding. During the last World War, he developed machines that became important in the production of munitions of all kinds, including a special machine for grinding Liberty aircraft engine crankshafts.

Mr. Norton held more than one hundred patents. He was a member of the American Society of Mechanical Engineers and a director of the Plainville Trust Co. He wrote many articles for technical journals and presented many papers on technical subjects before engineering societies. He is the author of "Principles of Cylindrical Grinding." In 1925, he was awarded the John Scott Medal "for the invention of accurate grinding devices of high power."

Nelson Jarvie Darling

Nelson Jarvie Darling, manager of the West Lynn and River Works of the General Electric Co., Lynn, Mass., died on October 26 at his home after an illness of a few months. He was fifty-eight years old.

Mr. Darling was born in Toronto, Ontario, Canada. He graduated from Cornell University in 1907, and upon his graduation, joined the General Electric Co.'s test course as a student engineer.

During the first World War he was closely identified with the design of machines for the manufacture of turbines for Navy destroyers, shells for the British and Russian governments, and gasoline-electric cars and electric locomotives. In November, 1918, he was appointed assistant manager of the Erie plant, and in 1922 manager of the River Works at Lynn, Mass. In 1935, he was made manager of the West Lynn Works, which position he filled in addition to his duties at the River Works.

BENNET B. BRISTOL, who with his brother Edgar H. Bristol, founded the

Industrial Instrument Co.—later the Foxboro Co.—in 1908, died at his summer home in Falmouth Heights, Mass., November 10, following several months' rest from a heart attack suffered last May. Mr. Bristol was born in Naugatuck, Conn., in 1868. He graduated in mechanical engineering from Stevens Institute of Technology in 1893. Ever since the formation of what is now the Foxboro Co., he served as its treasurer. He was also president of the Foxboro National Bank, a director of the Citizens and Manufacturers National Bank of Waterbury, Conn., and chairman of the Board of Trustees of the Foxboro State Hospital.

FRANK J. WESCHLER, vice-president of the Chain Belt Co., Milwaukee, Wis., and general manager of the Baldwin-Duckworth Division of that company, died suddenly November 10 in Worcester, Mass. Mr. Weschler was born in Erie, Pa. In 1902, he became connected with the bicycle industry in New England, and in 1906 joined the Hendee Mfg. Co., now the Indian Motorcycle Co. of which he became president in 1923.

In 1927, Mr. Weschler became affiliated with the Baldwin Chain & Mfg. Co., of Worcester, Mass., as president and treasurer. Upon the merger of that company with the Duckworth Chain & Mfg. Co. in 1930, he became treasurer and general manager of the newly formed Baldwin-Duckworth Chain Corporation. When this corporation, in turn, was merged with the Chain Belt Co. in 1939, he became vice-president of that company and general manager of the Baldwin-Duckworth Division.

NEW BOOKS AND PUBLICATIONS

SURFACE FINISH. 231 pages, 5 1/2 by 9 inches. American edition published by the American Society of Mechanical Engineers, 29 W. 39th St., New York City. Price, $3.25.

The American edition of this book has been produced in the United States with the permission of the Institution of Production Engineers of Great Britain. The text consists of a report of the research department of the Institution, prepared by Dr. Georg Schlesinger, director. The book contains a wealth of information on the subject of surface finish of metals which has recently been given such a great deal of attention. The investigations that form the basis for this report were started in July, 1939, and were carried on steadily until March, 1941. The book discusses the provision of standards for the measurement of surface finish and the determination of the type of finish best suited to a particular application.

GAS WELDING. 92 pages, 8 1/2 by 11 inches. Published by the American Technical Society, Drexel Ave. at 58th St., Chicago, Ill. Price, $1.25.

This book on gas welding is a recent addition to the job training units developed and tested by the staff of the Dunwoody Industrial Institute. This is the second of two manuals for training in welding, the first one, The Arc Welding Manual, having been reviewed in November MACHINERY.

The arrangement of the book is the same as in the other training units; for each job an information sheet, a job sheet, and check-up questions are provided. The equipment needed, general instructions, and operating steps are given for forty different oxy-acetylene welding jobs.

PLASTICS FOR INDUSTRIAL USE. By John Sasso, 229 pages. 6 by 9 inches. Published by the McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York City. Price, $2.50.

This is an engineering handbook of materials and methods containing information on the more important plastic materials that are particularly suitable for industrial applications. Emphasis is laid on comparative properties, methods of selecting for specific uses, and proper design. The first chapters give the basic information needed before any plastic can be adapted to engineering use. These are followed by separate chapters, each devoted to a specific plastic.

IMPORT-EXPORT CONTROL INDEX. 24 pages, 11 1/2 by 17 inches. Published by the New York Journal of Commerce, 63 Park Row, New York City. Price, 25 cents.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933,

of MACHINERY, published monthly at New York, N. Y., for October 1, 1942.

State of New York } ss.
County of New York }

Before me, a Notary Public in and for the state and county aforesaid, personally appeared Edgar A. Becker, who, having been duly sworn according to law, deposes and says that he is the treasurer of The Industrial Press, Publishers of MACHINERY, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, The Industrial Press, 140-148 Lafayette St., New York; Editor, Erik Oberg, 140-148 Lafayette St., New York; Managing Editor, None; Business Managers, Robert B. Luchars, 140-148 Lafayette St., New York; Edgar A. Becker, 140-148 Lafayette St., New York; and Erik Oberg, 140-148 Lafayette St., New York.

2. That the owners of 1 per cent or more of the total amount of stock are: The Industrial Press, 140-148 Lafayette St., New York; Robert B. Luchars, 140-148 Lafayette St., New York; Erik Oberg, 140-148 Lafayette St., New York; Edgar A. Becker, 140-148 Lafayette St., New York; Laura A. Brownell, 140-148 Lafayette St., New York; Franklin D. Jones, 140-148 Lafayette St., New York; First National Bank & Trust Co. of Montclair and Robert B. Luchars, Trustees (Beneficiaries unknown), Upper Montclair, N. J.; First National Bank & Trust Co. of Montclair and Leigh Roy Urban, Trustees (Beneficiaries unknown), Upper Montclair, N. J.; First National Bank & Trust Co. of Montclair and Kenneth D. Ketchum, Trustees (Beneficiaries unknown), Upper Montclair, N. J.; Paterson Savings Institution, Trustee (Beneficiaries unknown), Paterson, N. J.

3. That the known bondholders, mortgagees and other security holders are: Laura A. Brownell, 140-148 Lafayette St., New York; John Connolly, 140-148 Lafayette St., New York; Franklin D. Jones, 140-148 Lafayette St., New York; Robert B. Luchars, 140-148 Lafayette St., New York; Louis Pelletier, 140-148 Lafayette St., New York; Elizabeth Y. Urban, 163 Western Drive, Longmeadow, Mass.; Helen L. Ketchum, King St., Cohasset, Mass.; Wilbert A. Mitchell, 28 Harlow Road, Springfield, Vt.; and Henry V. Oberg, 1317 Hill Crest Road, R. D. No. 1, Lancaster, Pa.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

EDGAR A. BECKER, Treasurer

Sworn to and subscribed before me this 30th day of September, 1942

CHARLES P. ABEL

Notary Public, Kings County No. 313
(SEAL) Kings Register's No. 3109
New York County No. 231, New York Register's No. 3-A-161
(My commission expires March 30, 1943)

SAWING with SKILSAW IS SAWING with SPEED

on every production and maintenance job!

EVERY MAN

COUNTS FOR MORE

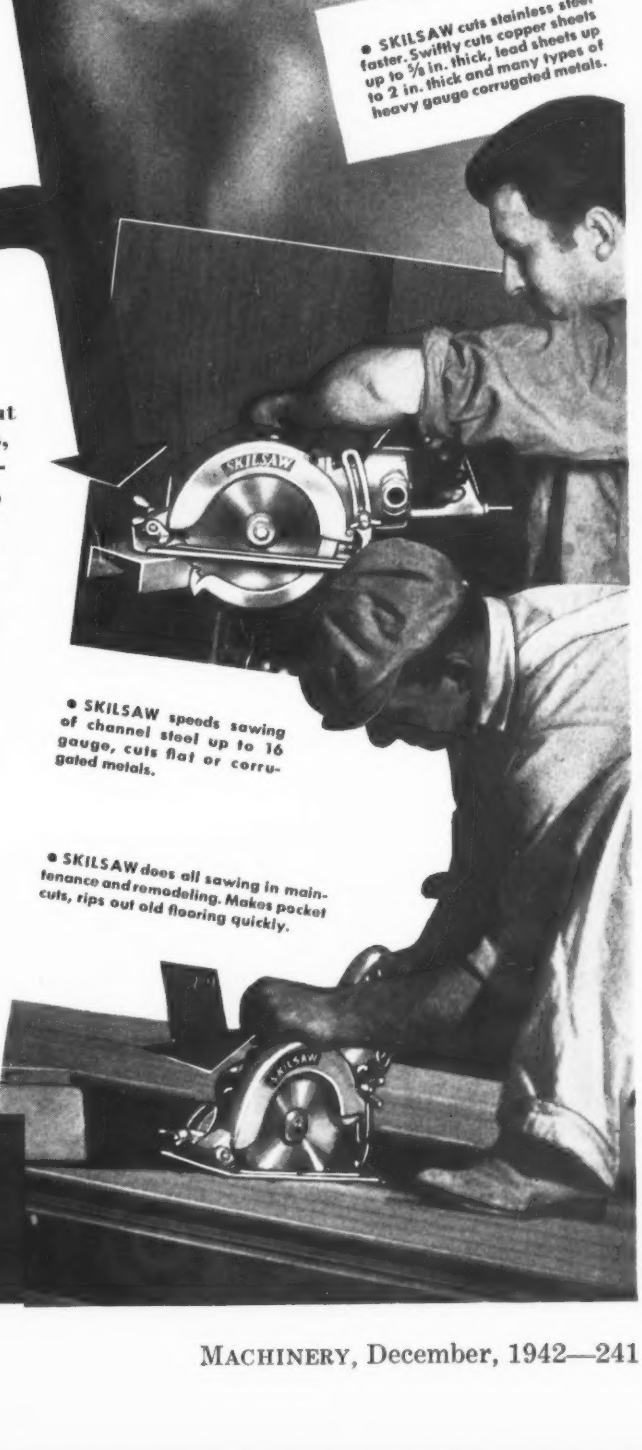
USING SKILSAW TOOLS!

• SKILSAW cuts stainless steel faster. Swiftly cuts copper sheets up to ⅝ in. thick, lead sheets up to 2 in. thick and many types of heavy gauge corrugated metals.

• SKILSAW is ideal for crating and uncrating. Depth of cut is adjustable to prevent damaging of contents.

Watch production jump when you put SKILSAW to work cutting sheet metals, cutting stainless, corrugated or channel steel up to 16 gauge, cutting wood, plastics, compositions. SKILSAW goes right to each job, eliminates slow material handling, cuts *faster, cleaner, truer* on every operation. It's the same on maintenance sawing where SKILSAW rips out old flooring quicker, speeds remodeling with less delay to production. And in shipping or receiving rooms, SKILSAW saves time on all crating and uncrating, saves material for other uses and protects contents of crates from damage in opening.

It's no wonder that SKILSAW is so widely preferred in War Plants everywhere. SKILSAW is lighter, more compact, more powerful. It handles easier, does more jobs, gets more work done, *faster*. Ask your distributor to demonstrate SKILSAW in your plant *today!*



• SKILSAW speeds sawing of channel steel up to 16 gauge, cuts flat or corrugated metals.

• SKILSAW does all sawing in maintenance and remodeling. Makes pocket cuts, rips out old flooring quickly.

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SKILSAW PORTABLE ELECTRIC TOOLS

★ *MAKE AMERICA'S HANDS MORE PRODUCTIVE* ★

Classified Contents of this Number